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INDEPENDENT TELEPHONE CONVENTION.

The Interstate Independent Telephone Association's convention, held at Chicago last week, was a remarkable one in several respects. It was remarkable not so much on account of anything that occurred on the floor of the convention as because of certain outside occurrences in connection with it. To begin with, there was that peculiar condition of affairs, namely, a convention without exhibits on the part of the large telephone manufacturers. The few exhibits which there were were made by manufacturers not exclusively in the telephone field and by smaller concerns. In fact, there was a practical boycott of the convention by the larger telephone manufacturers. The reason for this boycott appeared to be a feeling on the part of the manufacturers that they were not receiving proper treatment by the association, the charge being made that the association was forcing financial burdens on the manufacturers which were hardly justified. There were also many rumors that an attempt had been made by officers of the association to organize a telephone manufacturing and supply company on a co-operative basis. Such a move might or might not be detrimental to the present manufacturers. While on its face it might appear detrimental, the history of co-operative concerns in the past has not been such as to justify any great fear on the part of existing manufacturing concerns. There were also rumors that the attempts of the association to standardize apparatus were not favorably looked upon by manufacturers, as such standardization would necessarily mean the wiping out of some of the principal features or "selling points" of each manufacturer's apparatus. It is, however, a queer state of affairs when the manufacturing interests of a great industry feel obliged to take such drastic action as was taken regarding the Chicago convention. It is not our part to say who is right or wrong in the matter, but simply to record the reported "hard feelings" of both sides.

As to the real work accomplished by the convention, the principal thing was a movement to consolidate with the National Independent Telephone Association of America. The history of independent telephone associations in the past three years has been notable mainly for the amount of "turning over new leaves" that has been done. The national organization was originally formed for the purpose of protection against patent litigation. As the objects for which it was first formed became gradually fulfilled, there was a feeling that an association covering smaller territory than that of the national would meet the wants of the hundreds of small telephone exchanges in the central states better than the national organization, and this led up to the formation of the Interstate Independent Telephone Association. That two associations of such similar character could or should try to exist side by side was due partly to the feeling on the part of many that there was room for both associations and partly to a feeling of dissatisfaction on the part of some with the work of the national association under the guidance of the late Judge Thomas. When the national association met in Chicago in June, 1903, its affairs as a patent fighting organization were practically wound up, and it was the will of the convention, as expressed by a new constitution, that it be reorganized on an entirely new basis, making it a technical rather than a business organization. This would have kept it entirely free from interference with the work of the Interstate Independent Telephone Association had it been feasible to carry on the work on those lines.

In the interval between the National Convention of 1903 at Chicago and the convention of the same association in 1904 at St. Louis but little seemed to have been accomplished along the lines which the new constitution mapped out, and the principal thing accomplished by the St. Louis convention was another reorganization and a change of constitution. Soon after this St. Louis convention of the national body, it became apparent to officers both of the national and the interstate associations that something must be done to get these two associations together, as their separate maintenance could only result in harm to the independent telephone industry. While theoretically there might be a reason for the existence of both associations, it is not feasible practically at the present time to carry on the work of the two separately. The action of the manufacturers no doubt has been a factor in the decision to consolidate the two bodies, and a consolidation will probably mean the restoration of good feeling all around and much better conventions in the future. The independent telephone industry is, at the best, in a sufficiently unsettled state without making the matter worse with a multiplicity of organizations which interfere with each other's work.

FRENZIED MUNICIPAL OWNERSHIP.

We regret to note that the city committee of the Citizens' Union has adopted resolutions favoring an extension of the municipal control of public utilities, a municipal lighting plant, the purchase of electrical conduits in the Boroughs of Manhattan and the Bronx, the building of pipe galleries in connection with subway routes, and the granting of power to the city by the Legislature to build and operate lighting plants, both gas and electric. This is a large programme, which apparently has nothing for its justification except an attempt to "get at" the corporations now engaged in public lighting, whose bills for services rendered have already remained so long unpaid. We presume the matter has some political aspects with which we are not familiar, but that which interests us more directly as affecting some 3,000 electric lighting companies, is the wild repetition and dissemination of baseless statements as to the marvelous ease and economy with which the city can supply its own necessities if it had the power to construct and operate a municipal plant. Those of us who for many years past have found it necessary to buy imported spring water for our families rather than use Croton, and have many a day in the year found it impossible to bathe in the disgusting liquid furnished by the city, marvel that any citizens should be found who are anxious to put another public service under municipal management. If this were not enough, it would only be necessary to compare the public paving with the public lighting. The lighting, done under private contract, is unsurpassed in the world; the paving, done under municipal régime and responsibility, is unsurpassed in the world for vileness and is an utter disgrace to any self-respecting city; yet it is coolly proposed to give us more of the same sort of thing.

The record of municipal ownership in this country is not one of distinguished successes. It might, for many reasons, be characterized as one of distinct failures. Our columns have made frequent record of them, and new ones come to light from time to time. Moreover, with regard to the plants which continue in existence, it can be said with severe adhesion to truth that it is the most difficult thing in the world to get the exact facts in regard to them, and that the real cost of electric lighting by them is never fully stated; in short, it is always underestimated. We have had occasion ourselves from time to time to point out the inaccuracies in such reports as that from Detroit, which is but typical and symptomatic. Moreover, in making comparisons with New York no allowance is made by the persons using the figures for the different conditions under which plants in this city are compelled to operate. When the true facts emerge they are always found to support the contention of the contractor that the lights are being supplied at a rate that, all things considered, is moderate. Thus, for example, we note in the *Evening Post* of a few days ago a glowing account of the results of the municipal plant at Holyoke, Mass. It is stated that its board of public works pays to its gas and electric department, which operates the plant, $100 per year per light. Yet these lights, so far as we are aware, are none of them full arcs like those in New York City, and most, if not all, of the circuits are overhead. A moment's consideration would show, therefore, that in this city lights under private contract are cheap, and those in Holyoke under municipal ownership are dear. This one instance, paraded at this juncture by those who ought to know better, and who are fighting governmental control in other directions, is illustrative of the whole batch. Even if it were not, the fact that New York City is getting cheaper and better service than European cities of its own general size, where almost every element costs less, should be accepted as an indication that the prices are not exorbitant. In Paris the price of an arc light runs over $200 a year; in London it runs up to $150 a year in most of the large districts; in Berlin it amounts to over $100 a year, simply for the delivery of current at the base of the lamp. So far as quality of illumination goes, any one who has visited these other cities knows that New York can hold up its head proudly in the comparison.

Aside from all these direct considerations, the larger question arises of further increase of municipal taxation and further opportunities for municipal ownership, swindle and plunder, for which Manhattan Island has already afforded too many inglorious examples. We venture to direct attention to an article quoted elsewhere in our columns from a London newspaper, giving details as to the "frenzied municipal finance" which has already landed a great many towns and cities in England in straits, and which finds many of them raising short loans at high rates and anticipating their taxation. The gloomy picture thus presented is one, it seems to us, that should arrest the attention of every public-spirited New Yorker and make him hesitate before he gives support to another effort to commit the city to the management of a technical industry, whose fundamental principles are not yet entirely established and in which even yet revolutionary changes and advances must be expected. The overcapitalization that we hear about so much is often nothing more than a blind attempt on the part of a company to offset the burden of a service which was too cheap in the past, and to indemnify itself against the frequent sacrifice of apparatus that must be scrapped in order to keep up with the advances in the art.

THE EFFICIENCY OF COMPOUND-WOUND, DIRECT-CURRENT GENERATORS.

The article upon this subject by Mr. V. D. Moody, on page 1090 has a special interest in that it is stated to represent the actual results with a particular generator. That is to say, it represents a condition and not a theory. It is clear from the data and curves that the efficiency of such a machine differs but little from 90 per cent. between quarter load and an overload of one-quarter. In other words, the efficiency curve is very flat, and is not far from a straight line, between these limits. For many purposes this is a very desirable property. Within the ordinary working range the efficiency of the machine is substantially constant, and there is no particular load at which it is of any importance to operate the machine in order to secure maximum efficiency. It is also evident that there is an appreciable difference between the voltage generated at the terminals of such a compounded machine whether the load is increasing or decreasing. Although the difference in the two cases is less than

2 volts, and of no commercial importance in most cases, yet the influence of hysteresis in the terminal e.m.f. is quite visible. In practice, with such variations of load as ordinarily occur, the difference between terminal voltage on ascending or descending loads would be much less and the voltage would approximate to a mean curve. The resistance offered by the carbon brushes is also an appreciable element of the armature resistance. The loss of power in the brushes, by reason of their resistance, is a sacrifice made for the sake of keeping the brushes at a fixed position without sparking, under all conditions of load. The curve showing the resistance of the brushes as a function of the current density in their commutator contact surface is a curious one. The resistance is only about half as great for a current density of 60 amperes per square inch as it is for a current density of 10 amperes per square inch. This variation is doubtless connected with the heating of the brushes under load. The fall in resistance indicated is roughly such as would follow a uniform descent or straight line law, referred to the square root of the current density.

The test as a whole shows the great advance that technology has effected during the last ten years in reducing to standards the method of conducting such measurements, and the relatively high degree of precision acquired. In this direction the rules of the standardization committee of the American Institute of Electrical Engineers have proved of great service. The importance of standardizing dynamos so as to manufacture them in definite sizes, for definite scheduled speeds and voltages, cannot be overestimated. As pointed out in the article, this procedure permits the manufacturer to carry out the work of construction with far greater regularity, efficiency and economy than if each new machine formed a job of its own. The advantages secured to the purchaser are certainty of the capability of the machine, as derived from past experience with its prototypes, and promptness of delivery, to say nothing of the reduction in cost that standardized manufacture permits, in which advantage the purchaser—at least theoretically—benefits.

STANDARDS OF LIGHT.

The paper of Prof. Violle on this topic, presented at the recent International Electrical Congress, calls renewed attention once more to the very unsatisfactory character of the units in which a certain important commodity is sold. An aggregate of something like $85,000,000 changes hands yearly in the traffic in electric light in this country alone, and no other important article is so inadequately measured. If dry goods shrank from mere storage by amounts up to thirty per cent. and separate yard sticks, no two of the same length and all made of India rubber, were used for the different colors, what pandemonium would reign in the shopping district. Yet such is just about the condition of the trade in light. The customer buys electrical energy, it is true, which is measurable and measured with satisfactory exactness, as accurately on the average as cloth is measured. But one cannot read by electric current, and when this is transformed into light various amounts of divers degrees of usefulness become available. Lamps are of all sorts of efficiencies and colors and can be defined in power only by very troublesome measurements. Fortunately for central stations, they do not have to sell light by the flux—the total flux from a source—with all the confusion thereby implied. They have troubles enough without that. But no important product is measured by such unsatisfactory standards as is light, be it electric or other. This is perhaps to a certain extent unavoidable in a thing which cannot be measured without involving physiological quantities, and yet assuredly better standards and methods than we now have must be evolved ere long. To begin with, we need badly an absolute international standard of reference, and this once obtained we also need convenient secondary standards such as are discussed by M. Violle.

The Violle platinum standard tentatively used for absolute measurements has not come into sufficiently general use anywhere to give it an international commercial standing. Some practical difficulties in use and certain lurking distrust of ability exactly to reproduce it have hindered its adoption. The Hefner unit still holds the first place, empirical as it is and inconvenient as its color has proved to be in view of the illuminants introduced in recent years. Even the candle, unsatisfactory as it is acknowledged to be, has not been shaken from its legal lodgment. Acetylene gas and pentane have both come to the front as possible sources of absolute standards, the latter in a rather promising way. Both these last-named have the advantage of excellent color and of a convenient power much greater than the Hefner unit. For ready use even as absolute standards, the candle and the Hefner unit are too small even were they satisfactory in all other respects, which they are not. It strikes us that as a preliminary to the investigation of secondary standards undertaken by M. Violle, a general settlement upon a primary standard is a necessary prerequisite. One of the most useful works which an international body could undertake would be the agreement upon such a standard and efforts for its general legalization. M. Violle tacitly assumes his platinum standard as accepted. We wish that it were, but it has apparently not yet been sufficiently cleared of experimental difficulties. As to secondary standards properly so called, we think that the electric incandescent lamp properly constructed and aged is far and away the most practical yet proposed. Its power is good, its color is good and it is free from the vexatious corrections which afflict most or all flames. It is also cheap, so that it can conveniently be thrown away long before its permanence has been impaired by a sensible amount. There seems to us little use in a secondary flame standard save as an occasional convenience. With an incandescent lamp, one single thing—the voltage—has to be kept constant, and in these days that is a relatively easy task.

Granting some absolute standard back of the incandescent lamp, one could be reasonable sure of his basis of operations. Then the real trouble begins in the uncertainties attending color photometry. At this point the physiological aspect of the matter comes into prominence, and at the present time there is no sort of general agreement as to the proper basis of comparison in dealing with lights of various colors. Ordinary methods lead to results concordant perhaps but involving errors of unknown importance. Spectro-photometry gives a correct integration of the color elements of each light, but somehow it does not get anywhere and progresses with infinite toil. Lights of different colors are useful in different degrees for different purposes, and about the only general statement that can be made is that for ordinary purposes of seeing, light having the clear yellowish white of a high-efficiency incandescent lamp is far preferable to a light more strongly colored either with red or blue. There was much to be commended in Crova's plan of sifting out the more strongly colored components of each light and making photometric comparisons on the basis of the residuum. Certain forms of photometer automatically do something of the same kind, but there is involved the practical difficulty of strenuous commercial opposition to any scheme of measurement which would tend to discriminate against some vigorously exploited light of rather strong color. A good reading photometer is really much to be desired, but thus far all methods based on visual acuteness have proved of rather limited usefulness in spite of the fact that seeing by a light is the final and logical test of its usefulness. Yet seeing is a process involving so many factors that it does not promise much in the way of scientific exactness. There is room for immense advances in practical photometry.

The New York Electric Lighting Situation.

Once more attempts are being made to foster and work up an agitation in favor of a municipal electric light plant for New York City, and the usual mass of misinformation and misrepresentation is being brought forward in support of it. The wild craziness of the statements may be inferred from one in the New York *World*, which gives out to its own satisfaction that the cost of street arc lights could thus be cut down to $66 a year and that the city could save in this way $900,000 a year.

Mayor McClellan has given his support to a bill for a city plant, and the Citizens' Union has also "butted in." The City Committee of the Citizens' Union adopted resolutions this week favoring an extension of municipal control of public utilities, a municipal lighting plant, purchase of electrical conduits in Manhattan and the Bronx, the building of pipe galleries in connection with extensions of existing subway routes, and with future routes, and the granting of power by the Legislature to the city to build and operate lighting plants, gas and electric. The committee also adopted the report of the Committee on Franchises, which favors presenting to the Legislature a revised form of the constitutional amendment proposed by the Tilden Commission of 1875, which read originally that the Legislature should have no power to pass any law "for the opening, making, paving, lighting or otherwise improving or maintaining streets, avenues, parks or places, docks or wharves, or for any other local work or improvement in or for the city, but all authority necessary for such purposes shall be by law conferred on the city government."

The report of the Committee on Statistics of Public Utilities was received also. This report declares that the city does not possess specific powers to construct and operate city railroads or the more profitable ferries directly, to construct or operate gas or electric light, heat or power plants or telegraph or telephone lines.

More Underground Traction for New York.

Mr. Alexander E. Orr, of the Rapid Transit Commission, says that in the immediate future four underground lines will be built in New York—one on the east side, one on the west side, one from Fort Hamilton with the new East River bridge and one from Prospect Park to the Brownsville district of Brooklyn. He says that ultimately all the L structures will disappear and subways take their place. He believes that a bill will shortly be introduced at Albany to increase the tax on franchises. Projects contemplated for Manhattan alone will aggregate over $100,000,000 in cost.

Metropolitan Street Railway interests, under the advice of John B. McDonald, will favor the running of the proposed east side subway up Third Avenue instead of Lexington, as had been considered by the Rapid Transit Commission. It is believed that a Third Avenue subway would draw business from the present Fourth Avenue subway, and also from the Second and Third Avenue elevated lines, controlled by Mr. Belmont and his associates. At the same time the Third Avenue subway line would enable the maintenance of a practically straight line to a point in the Bronx where a connection could be effected with the proposed Port Chester road.

According to the tentative plans proposed by Mr. McDonald the east side subway would run from the Battery up under William Street and New Bowery to Chatham Square, up Third Avenue to connect with the Port Chester line for Van Cortlandt Park and Yonkers, then turn south, repass under the Harlem River, and return in a straight line under Seventh, Eighth or Tenth Avenue to Fourteenth Street, and then by way of Hudson and Greenwich Streets to the Battery, completing the circuit.

The Board of Rapid Transit Commissioners has also granted to the New York & Jersey Railroad Company, the McAdoo enterprise, a franchise of 25 years' duration to build a tunnel up Sixth Avenue, from the terminus of its Hudson River Tunnel at Christopher and Greenwich Streets, to Thirty-third Street, and a perpetual franchise to build a crosstown tunnel across the city under Christopher and Ninth Streets to Second Avenue.

Action was taken after a report from the Committee on Contracts, consisting of A. E. Orr, Edward M. Grout and Charles S. Smith. The signing of a contract was deferred until the next meeting. The New York & Jersey Company has received permission, however, to build now, so that it can go ahead with the work, which has been held up to await the action of the commission. The committee reported that it saw no objection to granting a franchise in perpetuity for the cross-town lines, because it was merely an extension of an interstate railroad, and would have but little value as an independent route.

Professor Ryan Leaves Cornell.

Prof. Harris J. Ryan has resigned his professorship in Sibley College, Cornell University, to accept a call to the head of the Department of Electrical Engineering of Stanford University, Palo Alto, Cal. The services of Prof. Ryan will be a decided acquisition to Stanford University, for aside from his acknowledged intellectual ability and his international reputation as a scientific investigator in the department of Electrical Engineering, he possesses as an educator the great gift of inspiring students with an enthusiasm in their work. In this latter respect he may be classed with such great educational forces as the late Profs. Rowland and Thurston.

Prof. Ryan is the third well-known member of the staff of Sibley College who has recently resigned. Prof. W. F. Durand, professor of marine engineering and naval architecture, has gone to Stanford University as head of the Department of Mechanical Engineering of that institution, and Prof. A. S. McAllister, assistant professor of electrical engineering, will come to New York to enter on editorial work.

Inspection Trip of the Interstate Telephone Convention.

The closing feature of the Interstate Independent Telephone Convention, which met at Chicago last week, and is reported elsewhere, was an inspection trip to the Waukegan plant of the American Steel & Wire Company. Mr. E. W. Green, traffic manager of the company, had arranged that a special train of six parlor cars be in waiting at the Chicago & Northwestern depot for the members at the close of the last session of the convention. After a run of an hour, during which a substantial lunch was served, the train was backed into the southern end of the Company's yards. Two hours were spent viewing the several interesting processes in the making of wire. The party was conducted through the mills in groups in charge of F. C. Gedge, superintendent of the plant; E. C. Lott and W. C. Stone, of the operating department, and C. S. Knight, of the electrical department. The explanations as given by these gentlemen assisted greatly in an understanding of the several processes viewed.

When the several groups emerged from the mills at the north end of the yards the train, which had been backed to this point, was in waiting. During the return to Chicago the party as a whole took the opportunity to express to Mr. G. F. Rummel, assistant general sales agent, who had the party in charge, and to the other officers of the American Steel & Wire Company its appreciation of the many courtesies extended to it.

Mr. G. A. Griswold, city passenger agent, and P. J. O'Brien, assistant superintendent of the Chicago & Northwestern Railway, who accompanied the party, were commended for the manner in which the detail of the trip had been carried out.

By the greater number of the 170 telephone men who made up the party, the manufacture of the wire, with which so much of their work is concerned, was viewed for the first time, and the opportunity of taking the inspection trip was, therefore, greatly appreciated.

Kern River (Cal.) Plant.

Advices from California state that the Edison Electric Company, of Los Angeles, Cal., will, by January 1, 1905, increase the force of men at present employed on its Kern River station to 400, and work will thereafter be vigorously pushed on the power plant to be installed there. The equipment will consist of an aggregate capacity of 25,000 kw. The hydraulic plant will consist of impulse wheels working under a head of 860 ft. and a flow of 16,000 miners' inches. The water will be diverted from the Kern River at a point 1,900 ft. above the power house and will be brought down to the station through a single tunnel 6 ft. in diameter, lined with No. 16 steel encased in concrete. The high-tension line to Los Angeles, a distance of 120 miles, will be supported by steel towers 75 ft. high and 600 ft. apart. The transmission voltage will be 60,000.

The Illumination of the Williamsburg Bridge, New York City.

ONE of the most interesting and important pieces of illumination carried out recently in New York is the lighting of the Williamsburg Bridge. This new avenue of traffic across the East River, between New York and Brooklyn, is a massive and conspicuous structure, as shown by some of the various engravings herewith. Its entire length is 7,200 ft., with a length between the towers of 1,600 ft. in the main span. The extreme width of the bridge is 118 ft. The height of the masonry in the tower foundations above high water is 23 ft., and the minimum height of the bridge above the medium high water of spring tides, for 200 ft. on either side of the center of the main span, is 135 ft. On the bridge there are two carriage-ways, each 20 ft. wide; two footwalks, each 12 ft. wide; four trolley car tracks, each 9¾ ft. wide, center to center; and two elevated railroad tracks, 11 ft. wide, center to center. These figures are enumerated with the idea of suggesting the difficulties of the lighting problem. A city street of the same dimensions, with the same variety of traffic and obstructed with the same complexity of structure, would be very difficult to light, but the bridge illumination enjoys no assistance from the direct lighting of adjacent stores as would a street, or from reflection. The problem of such work was first dealt with 20 years ago, when the Brooklyn Bridge was opened, depending simply on open arcs, and it is rather interesting that the latest methods recommended by practice and experience should now be carried out on another bridge, so nearby, crossing the same waters, and dealing more comprehensively with the same traffic conditions. Incidentally, it may be noted that the older Brooklyn Bridge is smaller, being but 6,537 ft. between terminals and 85 ft. wide.

FIG. 1.—FIREWORKS AND ELECTRICAL ILLUMINATION OF THE WILLIAMSBURG BRIDGE ON THE OPENING NIGHT.
(*From an untouched photograph.*)

The illustrations herewith afford an excellent idea as to the manner in which the lighting work has been done. At the present time there are 136 enclosed arcs in use and 500 incandescent lamps. The installation will be extended somewhat as the approaches and the comfort stations are finished; and electric pumps are to be installed at the piers for the purpose of providing an adequate water supply. It is also quite likely that the comfort stations may be heated electrically.

The contract for this work had been carried out and the service is being maintained by the New York Edison Company. Current is supplied to the bridge from both the Manhattan and the Brooklyn ends of the structure. In Brooklyn there is one service at South Fifth Street and Bedford Avenue, but in Manhattan it was found more convenient to feed in current from three points, namely, one each over Goerck, Ridge and Columbia Streets. An additional service will be introduced at Clinton Street to provide for the lighting of the New York trolley terminal. Direct current is used and is thus supplied over the Edison three-wire system at 120-240 volts. The service consists of lead-covered cables, each of 200,000 circular mils contained in 3-in. iron standpipes, which are attached to the Edison system in the streets below. Each cable ends in a service switch suitably enclosed on a distributing board, which contains the Edison meters and the switches and safety devices for the branch circuit. The lamps are furnished under city contract at a flat yearly rate, so that the meters are only for the convenience of the company in enabling it to watch current consumption. From the arrangement of the services it would appear that the lighting of the structure is divided into four distinct sections, to which a fifth will be added eventually. The chance of an interruption is thus lessened to the smallest degree, and it would be difficult to imagine the bridge altogether without light under any circumstances; but this chance, however small and remote, has been eliminated by the addition of double-throw switches, through which any section can be supplied from the section adjoining. In addition to this, the installation is joined up through an emergency switch at the center of the span, by means of which the entire structure can be fed into from either end. It would appear that all the emergencies and conditions likely to arise affecting service have been dealt with and met in order to prevent this great highway of traffic from being without adequate illumination. The wiring of the bridge has rubber insulation and is supported on porcelain insulators of special and novel design. The conditions of exposure on such a structure need not be enlarged upon for any one who has seen or crossed either of the East River bridges during a winter or summer storm; and insulation has, therefore, been given the utmost degree of consideration. Each circuit is controlled by a three-wire, knife-blade switch. While it is balanced at every point of supply, advantage has been taken of this system to so connect the lamps alternately that at the desire of the bridge authorities half of the installation can be used and still maintain a symmetrical though reduced volume of light.

The arc lamps used are of the standard city type, consuming 450 watts at the arc. They are suspended from the standard New York Edison type of street post with the graceful bishop's crook or swan-neck fixture, extended to carry the arc approximately 25 ft. above the roadway. This interesting change or evolution was introduced in order that the light of the lamp might be thrown not only upon the vehicular roadway below, but upon the pedestrian and bicycle paths upon the superstructure. These posts, which are well shown in some of the illustrations herewith, are spaced an average dis-

tance apart of 127 ft. There are thus two parallel rows extending across the bridge with the lamps opposite each other as distinguished from alternate spacing. The lamps are inspected three times nightly and are fully trimmed and cleaned weekly, the company employing for this purpose its automobile outfit, shown in operation. The lamps burn from sundown to dawn, following the city all-night schedule of about 4,000 hours. Some of the lamps are suspended, as shown, directly from the bridge structure, where post standards cannot be used.

The lighting when seen close at hand is eminently effective and satisfactory, and one crosses the bridge benefitting by a volume of illumination that is hardly equalled or surpassed by that of the most brilliant city street. This is the utilitarian side of the lighting and the only one to be considered practically. At the same time, the real beauty of the night effect is to be gathered at a distance, when with

FIG. 2.—THE BRIDGE ON A HAZY MORNING IN OCTOBER.

the piers, cables and truss work obscured in the darkness, the lighting of the structure forms an unsupported arch across the sky. This effect, while somewhat less beautiful then, is none the less striking when seen in the twilight, at which time both the purpose of the illumination and the means by which it is accomplished are easily discernible. One of the engravings herewith presents the bridge upon the opening night this year, when fireworks were called in to help celebrate the event and outline the structure to the eyes of the onlookers in each borough, but it may be questioned whether this pyrotechnic effect was in any way superior for beauty to that

FIG. 3.—SHOWING THE ARRANGEMENT OF THE LAMPS WITH POSTS OF UNUSUAL HEIGHT.

which the bridge has presented lately in its mantle of white snow, under the insistent steady beams of the long dazzling rows of arc lamps, against the dark background of the night.

In addition to the large amount of work thus required for the lighting of the bridge, the electrical work necessary for the electrical equipment of the double trolley tracks of the Brooklyn Rapid Transit Company was also notably extensive. This work, carried out by J. G. White & Co., included troughing, special terminal work, track construction, plaza work, overhead feeders and track

FIG. 4.—ON THE WEST ROADWAY. "AN AVENUE OF LIGHT."

return feeders. The Manhattan overhead construction is of special lattice work girders supported on steel poles and by attachment to the bridge structure proper, it being about 300 ft. long covering five

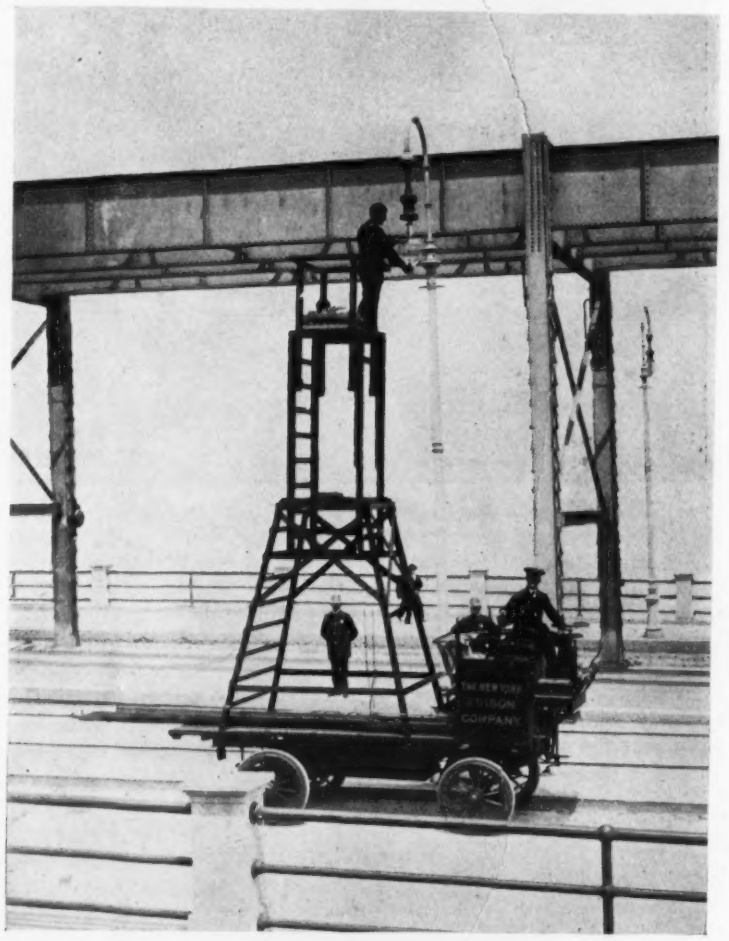


FIG. 5.—TRIMMING AND CLEANING.

cross-overs at the Manhattan terminal. At both ends of the bridge heavy brackets extend out over the double track and there is about 10,000 linear feet of single troughing between the towers. Altogether there are 15 miles of 782,000 circular mil, stranded, weatherproof aluminum feeder cable. Of this about eight miles are over-

head for the positive feeders and seven miles are along the tracks for negative returns. The positive feeders are erected on special 8-pin malleable-iron cross arms attached to the bridge structural

FIG. 6.—ANOTHER VIEW OF THE TRIMMING PROCESS.

work over the brackets on the approaches, and the cables are supported on malleable-iron pins with heavy feeder insulators. The negative feeders are carried on heavy porcelain insulators attached

FIG. 7.—SHOWING THE METHOD OF HANGING WHERE THE CABLE MAKES THE USE OF A POST IMPOSSIBLE.
(*The lamp may be seen above the automobile.*)

by lag bolts to the guard timbers, there being eight track feeder returns. On the Brooklyn approach near the bridge tower was erected a special steel frame switchhouse, encased in corrugated iron, from which point extend the overhead and track return feeders. Out on the plaza at the Brooklyn end of the bridge heavy steel poles were erected for the support of the overhead work. It will be seen from all these details that in many respects the Williams-

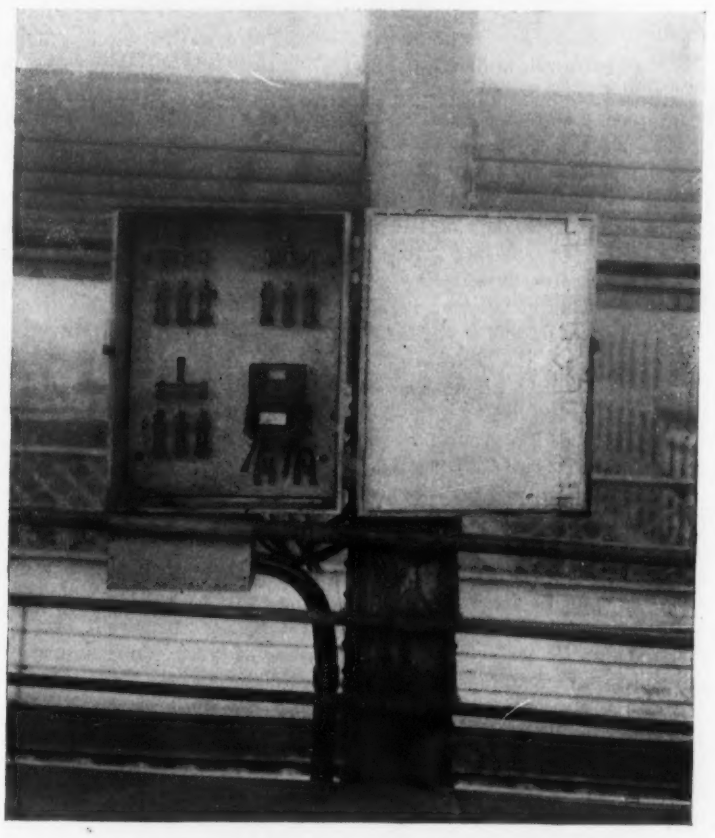


FIG. 8.—ONE OF THE EDISON SERVICES ON THE BRIDGE.

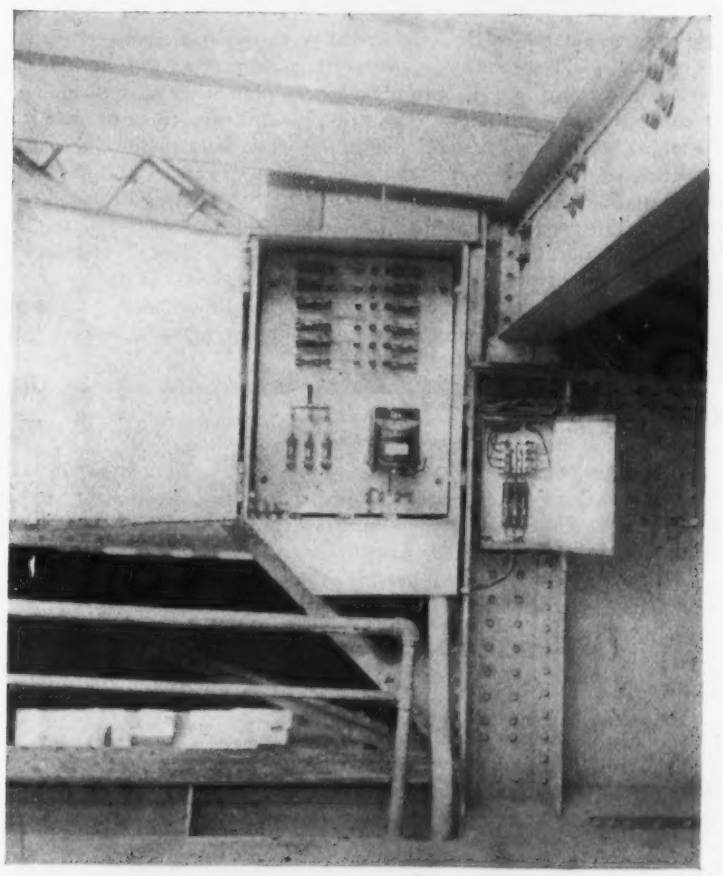


FIG. 9.—ONE OF THE SERVICE AND DISTRIBUTING PANELS AT THE NEW YORK END.
(*The connection at right is temporary.*)

burg Bridge, with its lighting, its traction work and its incidental requirements for electric pumping and heating—not to mention other details—is one of the most important pieces of electrical construction accomplished recently in this country.

The Erection of a 180-Foot Mast for Wireless Telegraphy and Telephony.

BY JOSEPH B. BAKER.

THE following account of the erection of a 180-ft. wireless telegraph mast, built up of three wood spars (lowermast, topmast and topgallantmast), will, it is hoped, be of interest and value to engineers who may be called upon for similar work, although steel towers have largely replaced wood masts for stations where the antenna reaches a much greater height than in the case here described.

The Stone Telegraph & Telephone Company, for which the mast was erected, actually had a 100-ft. structure, consisting of lowermast and topmast, already standing on the site—the unoccupied low-lying flat land on the Cambridge bank of the Charles River, near Boston. The two spars of this mast, respectively 75 and 45 ft. in length, they wished to use in the erection of a new mast, the plan proposed being to provide a new stick long enough and heavy enough as lowermast to carry the total height to a foot or two over 180 ft. The old mast was set 7 ft. in the ground, but was not guyed. Guys were thought necessary in the case of the new and higher structure, however, on account of the strong, occasionally gusty winds that have a full sweep for several miles over the open Cambridge flats. While it was intended to procure a strong and heavy stick for the new lowermast, able to withstand a high maximum wind pressure on its own surface and on that of its superstructure of topmast and topgallantmast, guying could not be dispensed with without risk of dangerous oscillations, set up by accidentally periodic gusts of wind. The nature of the soil in which the mast was to be set also rendered advisable the use of guys as main stays in holding up the 180-ft. structure; for although for a few feet down the soil was of good holding quality, below this was a bed of silt, almost as soft and yielding as a quicksand. As will be noted, the precautions taken not only in guying but also in stepping the mast made the whole structure largely independent of the nature of the soil in which it was set.

Inquiries that were made by the engineer into existing methods of fitting and erecting spars on board ship convinced him that the best way to get the work done would be to divide it into contracts, covered by rigid specifications in which each part of the work was allotted according to a definite prearranged plan without overlapping or conflicting of contractors' responsibility, and then to surpervise it. As might be expected in such a case, the work fully justified the engineering expended upon it in the saving of money that resulted from the limitation of each contractor's job to what he was accustomed to do in the regular course of work with his own men and tools. There was no sub-letting of contracts for any incidental jobs, little or big, except in the one instance of the transportation of the new lowermast to the site; nor were there any details unfamiliar to any of the contractors and affording excuse for an extra allowance of expense in making up their bids.

The contracts under which the work was executed were four in number, as follows:

1. Digging and refilling.
2. Riggers' work.
3. Sparmakers' work and furnishing of new lowermast, guy anchors (dead men), step and mud sills for lowermast, and iron fittings for lowermast and for topgallantmast, as to be described.
4. The providing of all other material used: hardware, steel guy strands and ropes, per the following list:

MATERIAL SPECIFICATION.

Twenty 3½-in. globe strain insulators, for dividing the guys into insulated sections.

1,400 ft. ½-in. diameter galvanized guy strand.

Ten dozen galvanized guy clamps.

Four pieces 11/16-in. steel chain, each 15 ft. long, painted, each with a 4-in. ring at one end and a "big link" at the other end for anchoring the guys.

Two 6-in. galvanized steel blocks, for antenna yard halyards.

750 ft. 1⅛-in. circumference tarred hemp rope, for antenna yard halyards.

375 ft. ¾-in. circumference tarred rope, for antenna yard braces.

The first step taken was the selection of a new mast long enough and heavy enough to carry the new structure 80 ft. higher than the existing mast. Allowance for deeper setting of the new mast and for sufficiently long "housings" at the splice between lowermast and topmast required a sound and well-proportioned pole at least 91 ft. long in the clear. Poles of such length are not very plentiful, and command a good price, although it is easy to find poles 80 ft. long and under. A search of the yards in the neighborhood resulted in the discovery of a stick about 92 ft. long that had been the mast of an old vessel. This mast had been in the water for years and was at first thought to be a white pine stick.

Upon getting this stick up on horses it was carefully inspected for ability to meet the specifications for "a sound, straight spar, preferably of Oregon pine, of length about 93 ft." A somewhat punky condition of the outer surface, some shallow scars at the "deck" where the mast had chafed in its former service, and a rotten place at one side of the butt did not interfere with the usefulness of the stick; for these defects were all removed in dressing down to the dimensions, shown in the sketch, Fig. 1, designed to give better pro-

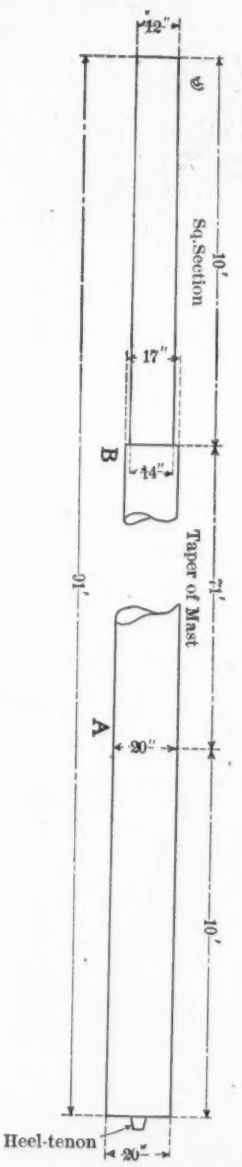


FIG. 1.—DIMENSIONS OF NEW LOWER MAST.

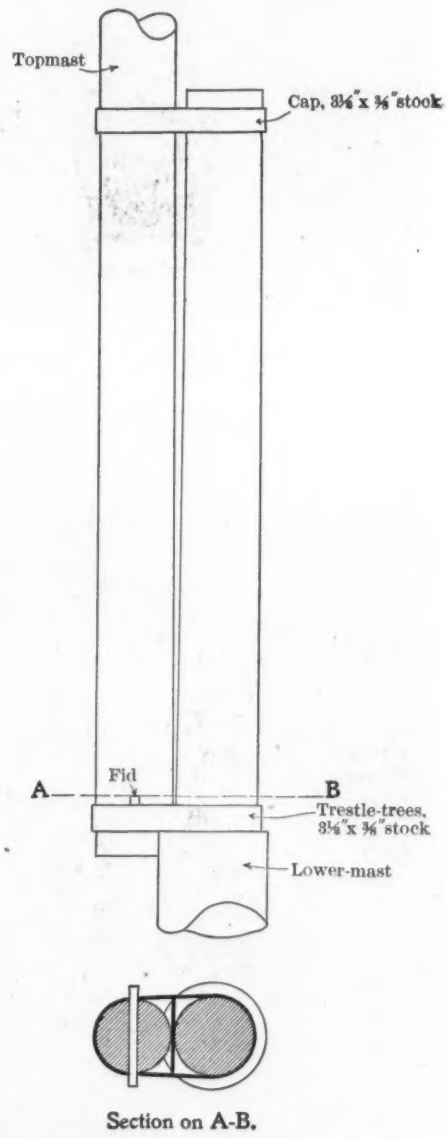


FIG. 4.—TOPMAST HOUSING OF NEW MAST.

portions for a lowermast to go with the other spars. As dressed the butt was fitted with a square tenon, for stepping into a mortised footplate as to be described. The diameter from butt to "deck" or ground level, *A*, was made 20 in., and the spar tapered from 20 in. at the ground level to 17 in. at the "hounds," *B*, giving a symmetry of outline to which the sketch, Fig. 1, hardly does justice. The 10-ft. topmast housing, *C*, was of chamfered square section, tapered from 14 in. to 12 in., as shown, thus giving a good shoulder for the trestle trees. Beyond a few season cracks, such as are almost always to be found in any large spar, the mast was a perfectly sound and good piece of timber.

Actual work on the site began by the breaking of ground by the

digging gang, the rigger's gang arriving on the same day with two 50-ft. spars, which they lashed together and set up as a shear, guyed to temporary anchors fore and aft, in position to root up the old two-spar mast. After "sending" down the comparatively light topmast, a pair of horses, hitched to a tackle seized on to the lowermast just below its center, soon had it down on the ground and out of the way.

Meanwhile the digging gang was at work in several squads digging the new mast hole, a short distance away from the old mast, and the holes for the four guy anchors, "deadmen," each 100 ft. from the pole, as indicated in Fig. 2. As the new mast was to stand in the middle of a sort of causeway four or five feet above the surrounding surface, it was necessary to carry the anchors 100 ft. out from the foot of the mast in order to run the guys to the pole at efficient angles. This location of the anchors required digging at points covered with from six inches to a foot of water, and the nature of the soil necessitated sheathing of all the holes as they were sunk. Below a top layer of sand and oyster shells, silt, so thinned with water seeping up from the river nearby as to be wellnigh as difficult as true quicksand, made the sinking of all five of the holes slow work, even with a good pump going all the time and three men (as many as there were room for) working in each hole. As fast as each anchor hole was dug the deadman—a 9-ft. length of Oregon pine spar about 14 in. in diameter—was placed in the bottom with a 15-ft. length of chain snared about its middle, and the hole filled up. These deadmen, 6 ft. down in the dense silt and crosswise to the direction of the pull of the guys to be attached to them, made the most secure

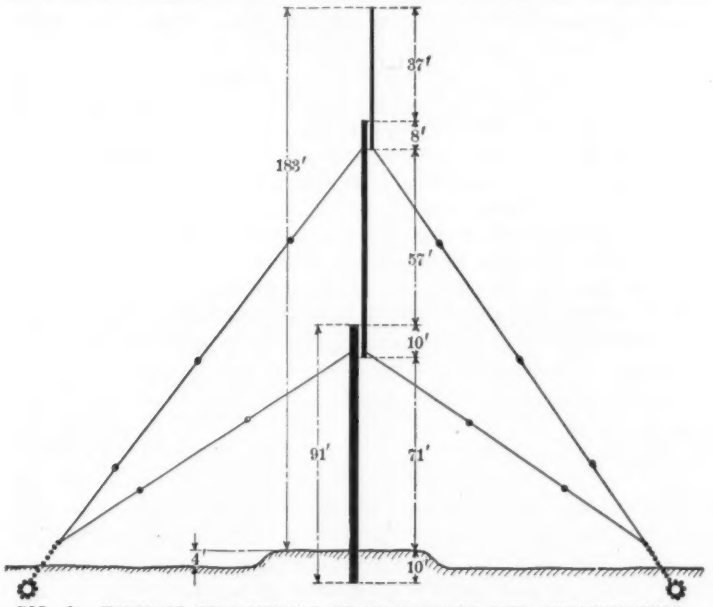


FIG. 2.—VERTICAL DIMENSIONS OF NEW MAST AND ARRANGEMENT OF DIVIDED GUYS, SHOWING STRAIN INSULATORS.

anchors possible. The 15-ft. length of chain attached to each log gave an end well above ground for the attachment of the steel strand used for the guys, a "big link" at this free end of each chain facilitating such attachment. (The line of guy chains should have been represented in the engraving as bisecting the angle between the upper and lower guys, and the distance of the guy anchors from the pole, it should be noted, is 100 ft.)

At the end of the third working day two anchors were planted and the hole for the new mast had been sunk part of the way down to its final depth of 11 ft. 3 in. The old two-spar mast had been taken down and its lowermast was on horses with a sparmaker at work on its heel, fitting it to be the topmast of the new structure. The new lowermast had arrived on the ground, and the rigger had moved his shear back to a point suitable for heaving up this mast, guying his shear to the permanent anchors. The fourth day of the work was consumed in pushing the digging job with additional men, and on the part of the rigger in making up in his loft the eight specially insulated guys designed to support the mast, ready to attach to the mast when set.

In the computations for the guys—two sets of four guys each—it was thought best to keep the strength of the spars themselves out of the calculation. That is to say, the strain due to wind pressure on the mast, using a high wind velocity pressure coefficient, was assumed to be borne wholly by the guys; the actual tension in each upper and lower guy, for the total pressure allotted to be sustained by it, being calculated by "resolution of forces" at the angle of each guy with the horizontal. These simple computations, with $tan^{-1}\frac{75}{100}$ for the lower set of guys and $tan^{-1}\frac{142}{100}$ for the upper set of guys (see Fig. 2), and the adoption of a factor of safety of 3, resulted in the selection of a standard galvanized steel strand of ½ in. diameter and 8,320 pounds breaking strain for all of the guys; the heavier wind pressure to be borne by the lower set as compared with the upper set being offset by their better guy angle, and vice versa.

The liberal wind pressure assumptions made in computing the guys were thought ample to cover extraordinary strains due to periodic gusts of wind in the exposed position of the mast. The strength of the individual spars and of the mast structure as a whole, set as to be described, was considered as "so much to the good."

The special interest of the guys for this mast, however, lay in the fact that each guy was divided into insulated lengths in accordance with a patent recently issued to Mr. John S. Stone. The usual plan in guying a wireless telegraph mast has been to insulate each guy at its ground end, generally by inserting between the anchor chain and the guy several strands of tarred rope, rove through wooden dead

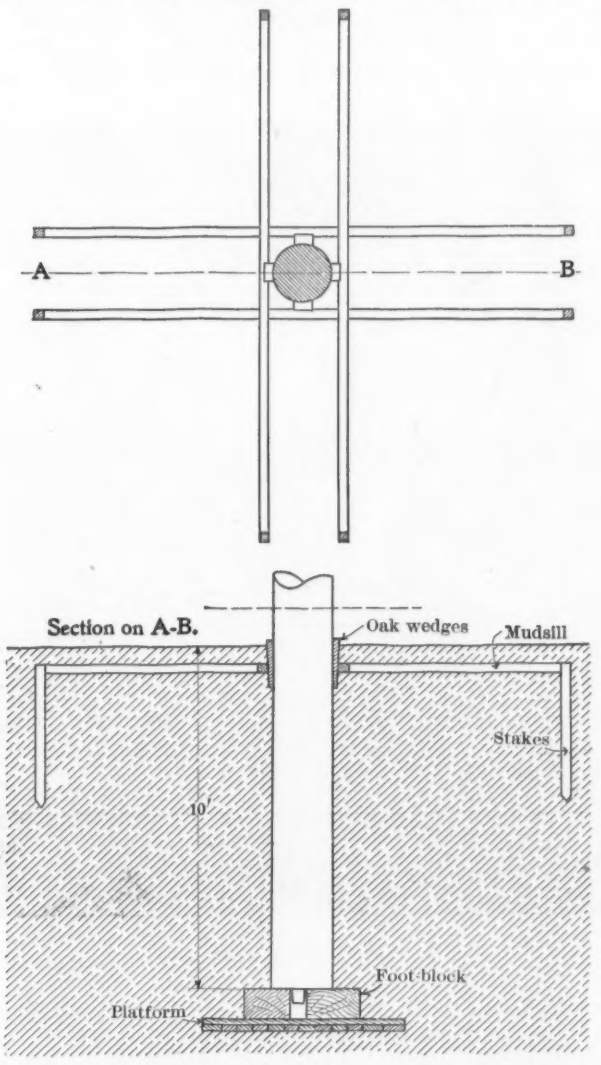


FIG. 3.—SETTING OF NEW MAST, SHOWING ARRANGEMENT OF MUDSILL AND FOOT BLOCK.

eyes. This gives a conducting guy rope of a length favorable to the setting up in it of powerful electrical oscillations, since its length is comparable to that of the antenna itself and it is exposed to the electromagnetic radiation; the group of guys surrounding the antenna thus exerting deleterious damping action upon radiation from the antenna in sending, and shielding action in receiving.

The plan followed in the construction of the present mast was to avoid this damping and shielding action by dividing each guy into sections, insulated from each other; the sections being so short compared to the length of the antenna or to the quarter wave length impressed upon it that they will be highly unfavorable to the setting up in them of the above referred to deleterious oscillations.

Fig. 2 shows this "divided guy construction." Each of the four

lower guys contains two "globe strain insulators" of mechanical strength substantially equal to the ½-in. diameter guy stand into which they are inserted. The guy, broken up, electrically speaking, into three 40-ft. sections, cannot now be the seat of electrical oscillations of any magnitude as a result of the signaling radiation. Similarly, each of the upper guys contains three insulators, dividing the guy into four 42-ft. sections. The 3½-in. globe strain insulators were adopted after exhaustive tests, kindly made for the writer by Prof. Miller, of the Massachusetts Institute of Technology, upon samples of several different kinds of strain insulators manufactured for trolley wire line construction. Four test samples of the "globe" form 3½ in. in diameter showed an average breaking strain of about 7,000 pounds, the weakest of the four breaking at 6,300 pounds.

In making up the guys, lengths of the steel stand were passed through the galvanized rings of the strain insulators and secured with galvanized guy clamps, two for each attachment to an insulator. At the anchor chains the lower guy sections were secured without the use of turnbuckles, the guys being pulled up by a tackle to proper permanent tension after the mast had been standing a day with guys attached and strained fairly taut.

The fifth day of the work saw the completion of the job. At the bottom of the 11-ft masthole was placed a rough 6-ft. square platform of two thicknesses of 2-in. by 8-in. spruce boards. To the top of this was spiked the foot-block or "step" of the lowermast—a 19-in.

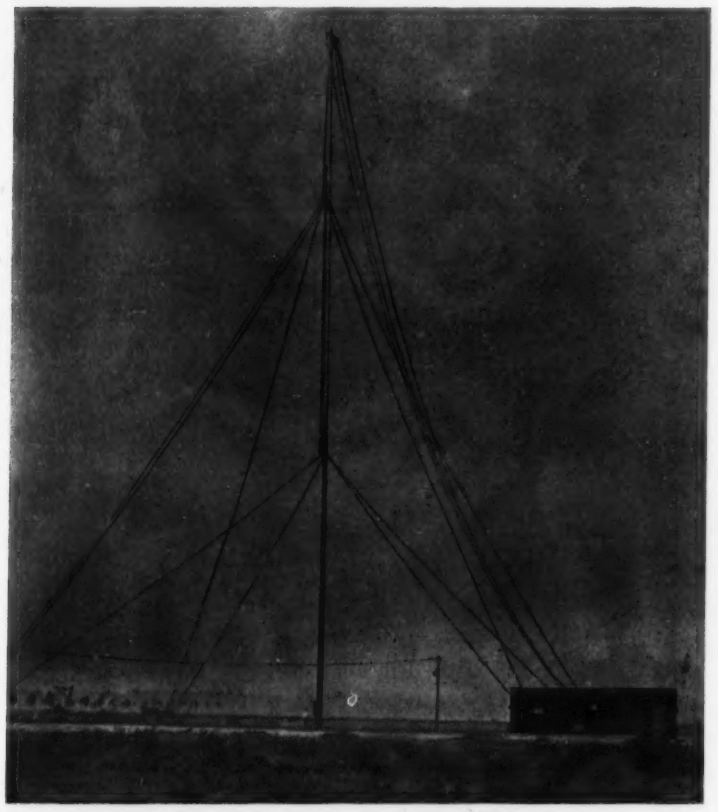


FIG. 5.—VIEW OF COMPLETED MAST.

by 3-ft. 3-in. spruce block 10 in. thick, having a tapered mortise at its center to receive the heel-tenon of the mast, as shown in Fig. 3. The new lowermast with its top fitted with wrought-iron trestle trees and cap, as provided in the sparmaker's contract, was heaved up on the rigger's shear and set into the step. With the weight of the lowermast still on the shear tackle, a man was sent up in a boatswain's chair to attach the lower guys. Each of these was carried around the mast just above the trestle-trees and secured with two guy clamps, the bights of the guys resting against forged corner irons spiked to the squared housing of the mast. By this time all four guy anchors had been planted, and the guys were attached to their chains and strained up sufficiently taut to bring the mast plumb; its hoisting tackle being at the same time gradually eased until the entire weight of the pole rested on its foot-block.

While the silt was being shoveled back into the hole the frame or mudsill, shown in plan and section in Fig. 3, was assembled about the deck of the mast, the tops of its four 3-in. by 4-in. by 15-ft. timbers coming about 6 in. below the general level of the ground. Four timbers were "halved" together, as indicated to form a frame embracing the pole with a slight clearance. The frame was firmly secured to the ground by eight 4-ft. spruce stakes driven down at the ends of the timbers as well as by being covered with 6-in. of the surface soil. When the mast had been brought up to plumb by the adjustment of the guys, four oak wedges were driven in the clearance spaces between the mast and mudsill. It is to be noted that this rigid wedging of the pole into a strong frame well secured to the ground, together with the fit of the heel of the mast in its buried foot-block, gives a setting of the mast that is largely independent of the nature of the soil.

The "sending up" of the old lowermast fitted as a new topmast, through the trestle trees and cap of the lowermast, was next accomplished, the hoisting tackle being passed over a block temporarily secured to the top of the now firmly set lowermast. A heavy iron "fid" of square cross-section driven through the heel of the new topmast and resting on the trestle trees of the lowermast took the weight of the topmast and made all secure. The splice between the two spars, shown in Fig. 4, was 10 ft. long.

The new topgallantmast (topmast of the old pole) which had been meanwhile fitted at its top with a welded iron band with two ears for halyard blocks, was then sent up through the old trestle trees and cap of the topmast, which were considerably lighter than those shown in Fig. 7. The halyard block band was slipped on the shouldered tip of the topgallantmast and nailed in place, 182 ft. above the ground, by a man sent up in a boatswain's chair, after the topgallastmast was in place resting on its fid on the topmast trestle trees. The splice between these two upper spars was 8 ft. long.

The attaching of the four upper guys, running from the hounds of the topmast just above its trestle trees, to the four anchor chains, and the rough adjustment of their tension, was next in order.

The rigging of a pair of 6-in. steel blocks to the topgallantmast band; the bending of halyards on to a light 12-ft. antenna yard 3 in. in diameter, and of other ropes for "squaring the yard" in adjusting the upper end of the antenna; and the spiking of a pair of halyard cleats to the mast near the ground, completed the work.

The photograph, Fig. 5, gives a fair idea of this mast as completed with an antenna of several strands of wire attached to the yard and pulled up to the top of the pole. It is noteworthy that the mast could

	Length over all.	Length to housings.	Butt.	Diameter. Top.
Lowermast.....	91	81	20″	below hounds 17″
Topmast.....	75	67	13″	below hounds 10″
Topgallantmast.....	45	37	7½″	4½″

easily be carried up to a height of 200 ft. by replacing the present topgallantmast, which is rather light, by a stick of about the length of the present topmast. No additional guying would be necessary. The photograph also gives a good idea of the flat nature of the ground, with the low causeway or bank on which the mast stands.

The above table gives the dimensions of the three spars of this mast.

Curtis Turbine Proposed for U. S. Warships.

Among the bids offered last week for the building of the armored cruisers *Montana* and *North Carolina* was one from the Fore River Shipbuilding Company, of Quincy, Mass., based upon a special design involving the use of Curtis steam turbines for propulsion. The vessels are to be of 14,000 tons displacement and have a speed of 22 knots. As the bids involved a departure from the naval specifications, the contract was awarded to the New York Shipbuilding and Drydock Company, whose bid was the lowest of the several offered.

A significant feature of the proposition is that it was made by a company of which Mr. F. T. Bowles, late constructor-in-chief of the Navy, is president. Mr. Bowles, who is one of the leading authorities of the world on warship design and conservative in his opinions, is reported as having stated that he is satisfied the steam turbine has great superiority over the present types of marine engines for vessels of the cruiser class, and that in the present case its adoption would assure a speed of greater than 22 knots. Enough weight would be saved by the turbines, moreover, to permit a change increasing the thickness of the main armor belt throughout its length between the 10-in. turrets from 5 inches to 6 inches, which at 3,000 yards would render the ship impenetrable by a 6-in. projectile and proof against a 5-in. gun.

The Power Factor Indicator.

BY HARRY W. RICHARDSON.

THE progress of any art or science, as it develops, depends upon recognizing the value of certain quantities, which in the early stages of the science have been overlooked or were known, but whose importance was not appreciated.

As the science of electricity progresses, there are many such quantities, which several years ago were recognized but their real merits did not at the time appear of commercial value. This is especially significant with the development of alternating-current transmission, where these quantities are well represented by voltage, frequency, power factor or wave form variations. The value of constant potential for a lighting circuit is an established fact, the value of a reasonably good power factor is becoming more and more imperative, and the effects of various wave forms and frequency variations are vigorously studied.

It is essential in the operation of rotary converters to know the power factor, for if this is known the field excitation may be maintained at such a value that the current in the armature will be a minimum. In the case of generators, the load on each may be so adjusted that each will do its proportionate amount of work.

There is little chance of decreasing the losses of generators, transformers, motors and such apparatus by increasing their efficiency except at excessive cost. For economical operation the central station must recognize the importance of some of these quantities which have been overlooked in the past. The power factor is at present one of the most important.

Formerly it was the practice to take simultaneous readings on two wattmeters or on an ammeter, voltmeter and single wattmeter, and after several readings by calculation determine the values of the power factor. This method required several testers, considerable time, was only approximate, and was extremely crude and unsatisfactory. With the development of the science, frequent, rapid and accurate readings have been necessary. This has resulted in the development of a class of instruments which would fulfill these conditions and at all times indicate the power factor direct.

All of the power factor indicators on the market are constructed upon the principle of the ratio of wattmeter readings by the two wattmeter method of measuring power—that is, they are for use on a two or three-phase circuit. Single-phase power factor indicators have been constructed, but are very susceptible to frequency and wave form variations. For single-phase circuits the "phase indicator" is employed. The phase indicator is practically a single-phase indicating wattmeter, in which the potential circuit lags or leads the current circuit by 90° and the needle is free to turn without control. When the power factor is unity the needle rests upon zero. As soon as any change of phase relation takes place, the needle swings to the side of the scale, indicating lag or lead, as the case may be.

At present, however, power factor indicators are only built for two and three-phase circuits.

The power factor indicator manufactured by the General Electric Company consists of a single fixed current coil wound in two sections, each section being placed upon either side of the shaft, which actuates the indicating needle. Enclosed by the current coil and mounted upon the shaft are the two potential coils. The potential coils are set at an angle to one another, this angle being of such a value as to produce a desirable scale. Changing this angle alters the scale distribution. The shaft is free to turn without control.

The Westinghouse Electric & Manufacturing Company produces a "power factor meter." This instrument comprises two current coils and one potential all wound on a common holder and in general appearance not unlike a Thomson recording wattmeter armature. Enclosed by these coils and mounted upon the shaft carrying the needle is an iron vane. The position of the iron vane for an indication is determined by the resultant rotating field produced by the two current coils and one potential coil. The shaft is free to turn without control.

The Elliott Bros., England, manufacture a power factor indicator consisting of one current coil which is movable and two fixed potential coils set at an angle but enclosed by the current coil. Current is led to the moving coil from the secondary of a small current transformer.

There is another power factor indicator made by Messrs. Everett, Edgcumbe & Co., England. This instrument is practically the same as the General Electric Company's indicator. It comprises two movable potential coils and a current coil which is fixed. As originally constructed, the instrument had three potential coils.

It seems to be the custom with German manufacturers to mark the scale of their power factor indicator in degrees from 0 to 90, so that they indicate the degrees lag or lead instead of the power factor.

Power factor is defined as the ratio of effective watts to the apparent watts. It is, therefore, the property or rather function of the circuit which defines the actual amount of energy available. Hence, its importance.

The embodying principle of operation for the power factor indicator is the measurement of power by the two wattmeter method. It is evident that if the load is unbalanced that each phase has its own power factor, hence an instrument in order to indicate the *true* power factor must be used on a balanced circuit. Should the circuit be unbalanced the resulting indication may or may not be approximately the average power factor of the different phases; it is more likely to be the vectorial sum.

The instrument for discussion should, therefore, be connected to a balanced circuit. For the sake of simplicity the General Electric Company's power factor indicator is chosen. The instrument as mentioned above comprises a stationary current coil and two potential coils, the latter being mounted upon the shaft actuating the indicating needle. The current flowing in the series coil produces a magnetic field upon which the current in the potential coils may act, thereby giving an indication. Should the phase of the current in the series coil change the magnetic field which it produces will change correspondingly and the potential coils will take up a new position due to this change. The needle will, therefore, give a new indication corresponding to the change in phase relation of the current. This change of phase relation is merely a variation of the power factor, so all that is necessary is to mark the instrument scale in terms of the power factor.

Our idea of the action of this instrument will be much more complete if we consider it from another point of view. If the instrument contained besides the series coil but a single potential coil it would be an indicating wattmeter pure and simple. If another potential coil is added the instrument becomes in a sense a "double wattmeter," the indications of which will be proportionate to the watts which the two potential coils in conjunction with the current coil attempt to indicate.

The theory of action of the power factor indicator so far has been merely descriptive and an explanation of this nature is rather unsatisfactory; its action may be made much clearer by the aid of mathematics.

A three-phase circuit will first be considered.

Fig. 1 shows the phase relations of the current and voltage for the different phases. Let O be the common Y connection of the gen-

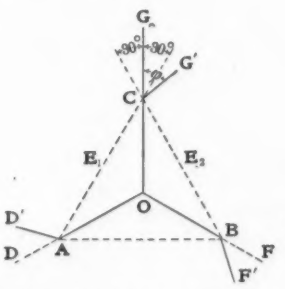


FIG. 1.—PHASE RELATIONS.

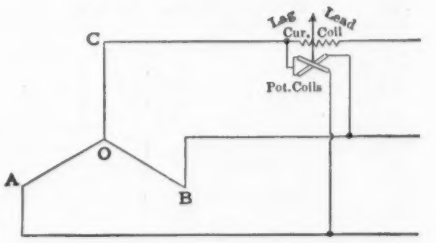


FIG. 2.—DIAGRAM OF CONNECTIONS.

erator, then each phase will generate a potential represented by OA, OB, OC. These three potentials are obviously at an angle of 120° from each other, giving a three-wire, three-phase system, with a potential across the lines equal to AB, AC, BC.

From trigonometry we know

$$AC = 2OA \cos 30° \quad \text{or} \quad AC = OA\sqrt{3}.$$

The current for any phase may be represented by extending the lines OA, OB or OC, and a lagging current shown by AD', BF' and CG'. Since the system is assumed balanced, these currents are of equal magnitude.

For the sake of convenience, the electrical quantities will be represented by letters as follows:

Let V = the voltage of any phase, OA, OB or OC.
E = the voltage across the line AB, AC or BC.
I = the current of any phase, AD', BF' or CG'.

Substituting these values in the equation $A\,C = O\,A\,\sqrt{3}$, we have $E = V\,\sqrt{3}$.

The current, $C\,G'$ (if lagging), is generated in the phase $O\,C$. The output in watts for this phase is $W = V\,I\,cos\,\phi$, where ϕ represents the angle of lag of the current, I, behind the voltage, V.

With this fundamental formula, it is now possible to take up the action of the power factor indicator. Referring to Fig. 2 as well as Fig. 1, the current coil is connected in series with phase $O\,C$; the potential coils are connected from C to A and C to B. In order to distinguish one potential coil from the other the one connected across C to A is No. 1 and its voltage E_1; the other potential coil across C to B is No. 2 and its voltage E_2.

Let W_1 = the watts indicated by coil No. 1 and the current coil.

W_2 = the watts indicated by coil No. 2 and the current coil.

then
$$W_1 = I\,E_1\,cos\,(\phi - 30°). \qquad (1)$$

This is evident from the diagram because by extending $A\,C$ the current, $C\,G'$, lags $(\phi - 30°)$ behind the potential, $A\,C$.

$$W_2 = I\,E_2\,cos\,(\phi + 30°) \qquad (2)$$

This is also evident because the current, $C\,G'$, lags $(\phi + 30°)$ behind the potential, $B\,C$.

Since the two potential coils are mounted upon the same shaft, which actuates the needle, the deflection of the needle must necessarily be the ratio of the watts indicated by coil No. 1 to the watts indicated by coil No. 2. Expressing this ratio from equations (1) and (2):

$$\frac{W_1}{W_2} = \frac{I\,E_1\,cos\,(\phi - 30°)}{I\,E_2\,cos\,(\phi + 30°)} \qquad (3)$$

Equation (3) is then what the needle really indicates.

The quantity I will cancel. It will be remembered that the potentials E_1 and E_2 are equal and may, therefore, be cancelled, leaving

$$\frac{W_1}{W_2} = \frac{cos\,(\phi - 30°)}{cos\,(\phi + 30°)} \qquad (4)$$

The cancellation of the quantities I, E_1 and E_2 shows that the deflection of the needle is unaffected by any change in the value of the current or potential so long as the system is balanced.

Equation (4) reduces trigonometrically to

$$cos\,\phi = \frac{sin\,\phi}{\sqrt{3}} \cdot \frac{W_1 + W_2}{W_1 - W_2} \qquad (5)$$

Equation (5) as it stands means that any change in the watts due to phase variations will alter the deflection of the needle in accordance with cosine of the angle of lag (or lead). Since the power factor numerically equals the cosine, that is, the power factor on the scale, the instrument furnishes instantaneous indications reading direct in terms of the power factor.

Fig. 3 is a diagram representing phase relation for a two-phase

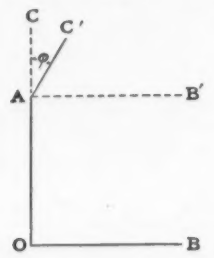


FIG. 3.—PHASE RELATION.

power factor indicator. The current coil is in series with phase $O\,A$; potential coil No. 1 across O to A, coil No. 2 across O to B.

The indication of the needle for the two-phase instrument is $\frac{W_1}{W_2}$ as in case of the three-phase circuit giving

$$\frac{W_1}{W_2} = \frac{I\,E_1\,cos\,\phi}{I\,E_2\,cos\,(90° - \phi)} \qquad (6)$$

As in the previous example, E_1 and E_2 are equal, hence the current and potential will cancel, leaving

$$\frac{W_1}{W_2} = \frac{cos\,\phi}{cos\,(90° - \phi)} \qquad (7)$$

This equation means that variations of current or voltage do not affect the indications. Reducing equation (7) trigonometrically, it becomes

$$\frac{W_1}{W_2} = \frac{cos\,\phi}{sin\,\phi} \qquad (8)$$

Equation (8) shows the indications of potential coil No. 1 are proportional to the energy component and that coil No. 2 is proportionate to the wattless component. These are the functions which determine the power factor. Transposing equation (8) it becomes

$$cos\,\phi = sin\,\phi\,\frac{W_1}{W_2} \qquad (9)$$

This then is the indication of the needle for the two-phase power factor indicator.

Efficiency of Compound-Wound, Direct-Current Generators.

By V. D. Moody.

ELECTRICAL apparatus, both direct and alternating current, has practically reached that stage in manufacture which is classified as standard, which means that machines of certain capacities and speeds have become standardized for purchasers' usage. This is both beneficial to the manufacturer and purchaser. To the manufacturer it means the practical elimination of special designs and patterns which would probably only be applicable to the apparatus under consideration; and to the purchaser a cheaper piece of apparatus, as no development charge for manufacture is entailed; also, earlier deliveries of apparatus, which in itself is a point of vital importance. These matters of price and delivery should be strongly considered by the purchaser, and when possible the consulting engineer's or contractor's specifications should always be drawn so that a standard piece of apparatus can be procured, as there will in every case be considerable saving in first cost of installation, which in most cases is of importance.

At times conditions exist wherein it is essential to specify electrical apparatus to perform certain duties, covered by specifications submitted to the manufacturer, standard apparatus not meeting the conditions as to efficiency, etc.

Standard apparatus, so to speak, consists of a line of machines which have been subjected to severe tests, as laid down by the Standardization Committee Report of the A. I. E. E., covering temperature rise of the different parts after a heat run of many hours' duration until constant conditions exist, including insulation tests, efficiency, etc. There is no question as to the reliability of the apparatus which is called standard, if built by reputable manufacturers. Even these machines are given a heat run of several hours' duration in the testing room before shipment; that is, they are given insulation test before setting up on the testing floor, then they are run with normal load and voltage for six or eight hours, after which the temperatures of the different parts are measured by thermometer, and the insulation test again applied in order to ascertain whether any deterioration has occurred.

In computing the efficiency of a compound-wound, direct-current generator with accuracy, it is essential to make several special tests on the machine, consisting of the saturation curve and core loss test. It is also well to make a compounding test, in order to ascertain wherein the voltage varies for different loads applied.

The machine should first be operated at normal load and voltage until it becomes well heated up to constant conditions of operation. As the field usually requires the longest time to attain its condition of temperature, and therefore of resistance at full load, the commercial test for constant conditions of operation is to observe occasionally the field voltage for a given value of field current. When the field voltage is constant for a given value of field current, the temperature and resistance of the field is constant and the machine is in the specified constant conditions of operation. This test usually takes six or eight hours, depending of course upon the size of the generator.

In connection with the several tests which are essential for accurate calculation of the efficiency of a compound-wound generator, an actual case will be taken for demonstration, with the necessary curves plotted. The rating of the generator under consideration

will be a 100-kw, 6-pole, 230-r.p.m., 116-118-volt, compound-wound machine.

When the generator has reached the constant conditions of operation, the compounding test is made. A variable shunt, consisting of several strips of German silver, is often placed across the terminals of the series field to obtain the desired flexibility as to over-compounding. This test is started with no load on the machine, the generator having been run for several hours, until it has reached the constant conditions of operation, with the adjustable shunt in the circuit. The shunt is then adjusted to give the full load compounding and full load is put on the machine, the source of load consisting, for testing purposes, of a water rheostat. In making this test it is essential that the speed of the generator under test be held constant, i. e., at the normal speed of the machine. The generator is belted to a motor, the latter having a suitable variable resistance

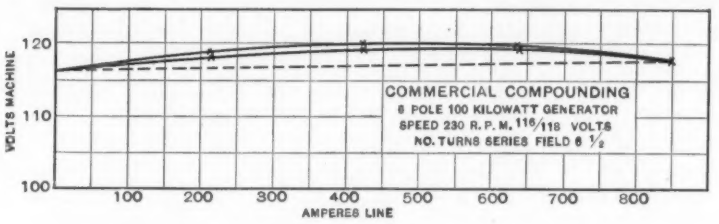


FIG. I.—EFFICIENCY CURVES.

in the field circuit for varying the speed, and the former a variable resistance in its shunt field circuit for adjusting the excitation. When full load is thrown on the generator, speed constants and normal meter readings are taken of machine volts, line amperes, field volts and field amperes. The load is then reduced to ¾ full load, then to ½, then to ¼, and finally no load, the meter readings as specified above being noted for each variation of load, the speed in all cases being held constant. The load is then increased to ¼ full load, then to ½ load, to ¾ load, and finally full load, the same readings being taken. It should be noted here that during the

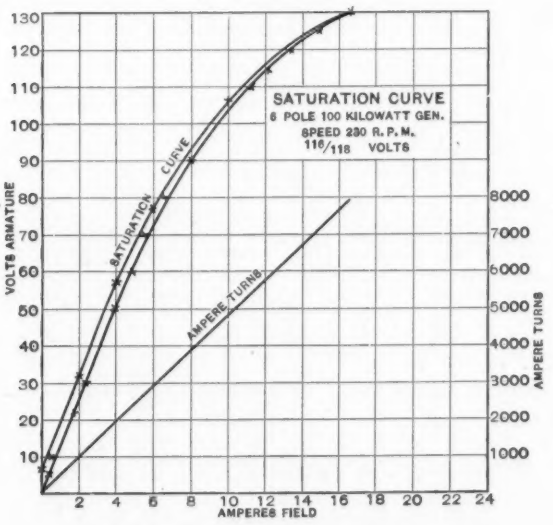


FIG. 2.—SATURATION CURVE.

compounding test the field rheostat of the machine under test should not be manipulated after the no-load setting. The curve is plotted with line amperes as abscissæ and machine volts as ordinates.

LOG OF COMMERCIAL COMPOUNDING.

Load.	Volts, machine.	Amps., line.	Volts, field.	Amps., field.	Speed, r.p.m.
Full load	118	848	87.7	11.6	230
¾ load	120	636	88.7	11.75	230
½ load	120.5	424	88.3	11.70	230
¼ load	119	212	87	11.58	230
No load	116.4	0	85.6	11.3	230
¼ load	118	212	86.4	11.48	230
½ load	119.2	424	86.4	11.48	230
¾ load	119	636	87.7	11.6	230
Full load	118	848	87.4	11.59	230

After this test has been completed the machine is operated a short while under normal load and voltage until the constant conditions of operation are again reached, as in making the above test the generator may slightly cool off. The generator is then shut down and resistances of the fields and armature are measured, a high-potential test applied and the temperatures taken; also the length, breadth and width of the shunt are measured, and the number of strips in multiple noted. This is essential in order that the necessary shunt may be made up for shipping with the generator.

The saturation curve gives the induced voltage or terminal voltage at open circuit and normal speed as functions of the ampere-turns per pole of field excitation. The saturation curve taken with the decreasing field excitation does not coincide with that taken with increasing field excitation, but is higher, which is due to the remanant magnetism or hysteresis of the iron part of the magnetic circuit.

This test is preferably made with the generator operating at normal speed, belted to a motor of suitable capacity with the brushes on the neutral point, and is made with both rising and falling field current, which will determine the residual magnetism of the frame or iron part of the circuit. The machine being operated at normal speed, the field current is increased by small increments, and

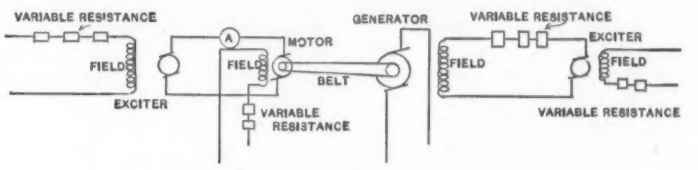


FIG. 3.—CONNECTIONS FOR CORE-LOSS TEST.

readings taken of armature volts, field volts and field amperes until the voltage has been increased about 25 per cent. above the normal full-load voltage. The field current is then decreased in increments, the same readings being noted until zero field current is reached. This curve is plotted with field amperes or ampere-turns as abscissæ and armature volts as ordinates.

LOG OF SATURATION CURVE.

Volts, armature.	Volts, field.	Amperes, field.	No. turns, shunt field.	Ampere-turns.	Speed, r.p.m.
5	1.5	.18	480	85.5	230
10	5	.62	480	297	230
22	12.3	1.62	480	777	230
30	17.3	2.3	480	1103	230
40	23.5	3.1	480	1485	230
50	29	3.95	480	1895	230
60	36	4.84	480	2320	230
70	41.8	5.57	480	2670	230
80	49.5	6.63	480	3180	230
90	58.6	7.87	480	3788	230
100	68	9.11	480	4370	230
110	84	11.15	480	5350	230
115	91	12.16	480	5825	230
120	100	13.4	480	6420	230
125	110	14.83	480	7110	230
130	122.5	16.6	480	7955	230
105.5	85.9	10.0	480	4800	250
77.0	48.0	6.0	480	2850	230
31.5	17.0	2.0	480	950	230
6.0	....	0	480	600	230

The core loss test is made by belting the generator to a motor, the capacity of which is about 15 per cent. of the machine under

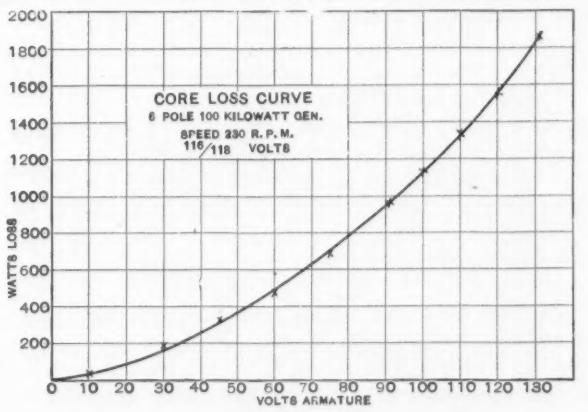


FIG. 4.—CORE-LOSS CURVE.

test, the pulleys of the motor and generator being of such a diameter that the machine under test will operate at normal speed; the speed in this test is of vital importance. The motor and shunt field of the generator are both separately excited, there being connected into the fields a variable resistance for varying the speed of the motor, and hence the generator, and for varying the generator field excitation.

In this test readings are taken on the generator of armature volts and field amperes, the speed being held constant; and on the motor

of armature volts, armature amperes and field amperes. Adjoining is given a log of tests and calculation of core loss which is self-explanatory, the core loss being the difference in watts between the reading with no field on the generator and the succeeding readings. The core loss curve is plotted with armature volts of the generator as abscissæ and watts loss as ordinates.

Core Loss Test. Driving motor 15-H.P., 800 r.p.m. — *Generator Under Test.* 100-kw, 230 r.p.m.

Volts, armature.	Amperes, armature.	Amperes, field.	Watts, armature.	I^2R, armature.	Watts—I^2R, armature.	Core loss.	Volts, armature	Amperes, field.	Speed, r.p.m.
103.3	28	1.25	2900	102	2798	0	0	0	230
103.5	28.2	1.25	2920	103	2817	79	10	.81	230
103.5	30	1.25	3110	117	2993	195	30	2.31	230
103.8	31.4	1.25	3260	128	3132	334	45	3.5	230
104	33	1.25	3430	142	3288	490	60	4.72	230
103.3	28	1.25	2900	102	2798	0	0	0	230
104	35	1.25	3640	159	3481	683	75	6.18	230
104	38	1.25	3950	187	3763	965	92	8.10	230
104	39.5	1.25	4110	202	3908	1110	100	9.55	230
104	42	1.25	4360	229	4131	1333	110	11.64	230
103.3	28	1.25	2900	102	2798	0	0	0	230
104.2	44	1.25	4590	252	4338	1540	120	14.07	230
104.2	47.5	1.25	4950	293	4657	1859	131	17.7	230
103.3	28	1.25	2900	102	2798	0	0	0	230
Belt on									
102.5	15	1.25	1540	29	1511	0	0	0	230
Belt off									
102	8.3	1.25	846	9	837	674	0	0	0

Constants.

Resistance motor armature, hot, .13 ohms; resistance generator armature, hot, .00575 ohms; resistance generator shunt field, hot, 7.6 ohms; resistance generator series field and German silver shunt, hot, .00143. Size generator brushes, 1¼ in. x 1¼ in. carbon; number of studs, 6; number of brushes per stud, 6; number turns shunt field, 480; series field, 6½. Brush contact resistance, .00214 ohms.

The foregoing tests having been made, and the resistances measured of the generator armature, shunt field and series field and German silver shunt, the efficiency of the machine may readily be calculated.

LOG OF EFFICIENCY.

100-Kw Generator, 230 r.p.m., 116 volts no load, 118 volts full load.

Load.	125	100	75	50	25
Volts, line	118.5	118	117.5	117	116.5
Amperes, line	1055	847.5	638	427	217.5
Amperes, field	12.45	12.35	12.3	12.3	12.25
Amperes, armature	1067.45	859.9	650.35	439.3	226.75
IR, armature and brushes	8.4	6.77	5.14	3.46	1.8
IR, series field and Ger. sil. shunt	1.51	1.21	.92	.61	.36
Total IR drop	9.91	7.98	6.06	4.07	2.16
Volts + IR	128.41	125.98	123.56	121.07	118.66
Losses, watts.					
Core loss	1770	1700	1630	1570	1520
I^2R, armature and brushes	8980	5770	3320	1520	407
I^2R, shunt field and rheostat	1475	1462	1450	1440	1430
I^2R, series field and Ger. sil. shunt	1592	1028	582	261	65
Brush friction	415	415	415	415	415
Bearing friction and windage	259	259	259	259	259
Total losses, kilowatts	14.491	10.634	7.656	5.465	4.096
Kilowatt input	139.491	110.634	82.656	55.465	29.096
Kilowatt output	125	100	75	50	25
Per cent. efficiency	89.5	90.4	90.6	90.3	86

As shown, the efficiency curve is plotted with line amperes as abscissæ and percentage of efficiency as ordinates. In Fig. 5 is also plotted a curve of carbon brush resistance with amperes per square inch contact as abscissæ and ohms per square inch contact as ordinates. The use of this curve is explained below, and as well as of the curves of losses for different loads.

Referring to the log of efficiency, the following explanations apply to the methods of computing the various losses.

Line volts for a flat compounded machine are the same for all voltages; otherwise the line volts vary proportionally to the percentage load.

Line amperes are computed by dividing kilowatt output by line volts.

Field amperes for a flat compounding can very readily be computed from the compounding curve; otherwise the field amperes are taken from the saturation curve by looking up on this curve the field amperes for no-load voltage. The value obtained will vary directly in proportion to the voltages for either loads; for example, if the field amperes for 116 volts = 12 for 118 volts, they will equal

$$\frac{12 \times 118}{116} = 12.21.$$

Armature amperes are the sum of field amperes and line amperes.

The armature resistance is measured after the heat run, and the brush resistance is calculated as follows:

Number of brushes per stud, 6; number of studs, 6; size of brushes, 1¼ in. x 1¼ in. carbon; total brush area for one side in square inches = area of the brush × number of studs × (number of brushes per stud ÷ 2). Amperes per square inch contact = armature amperes ÷ brush area for one side. Resistance per square inch is obtained from the curve of carbon contact resistance on curve sheet No. 4. Total brush resistance = (resistance per square inch × 2) ÷ total brush area for one side.

Having obtained the brush resistance and knowing the armature resistance, the sum of the two multiplied by the armature current gives the IR drop in the armature and brushes.

The IR of the series field and German silver shunt is the product of the line amperes and the measured hot resistance of the series field and shunt.

If it is desired to segregate the IR drop in the series field and German silver shunt, in taking resistance measurements the combined resistance of the field and shunt, as well as the resistance of the field alone, should be noted. Then the current in series field = (combined resistance × line amperes) ÷ resistance of the series field.

The resistance of the German silver shunt = (combined resistances

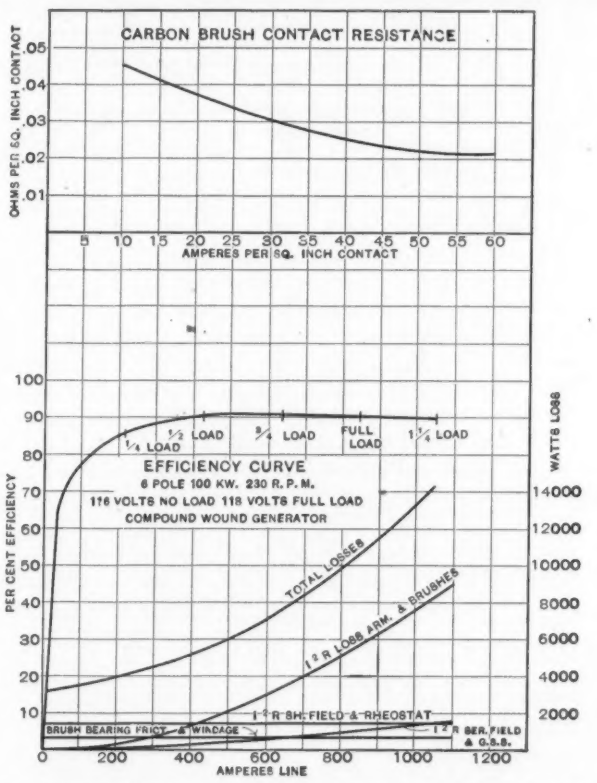


FIG. 5.—BRUSH CONTACT RESISTANCE CURVE AND EFFICIENCY CURVE.

× resistance of series field) ÷ (resistances series field — combined resistance).

The current in the German silver shunt = line amperes — series field amperes.

From the foregoing the current in the series field and German silver shunt is known; also the resistances, from which the IR drop is readily calculated.

The core loss is obtained by referring to curve sheet No. 3 and noting watts loss for volts + IR drop.

The I^2R values are readily obtained, as the resistances of fields, armature and brushes are known.

The brush friction is computed as follows: I = circumference of commutator in feet; n = r.p.m. of machine; a = total brush area in square inches; p = pressure of brushes per square inch in pounds; u = coefficient of friction = .2 for carbon.

Then the brush friction = $(I \times n \times a \times p \times u \times 746) \div 33{,}000$.

Bearing friction and windage is the difference between the losses obtained, referring to log of core loss, with belt on and off and the brush friction.

Röntgen-Ray Anniversary.

The tenth anniversary of the discovery of X-rays by Röntgen will be celebrated in Berlin, April 30, 1905, when a congress will be held for the purpose of discussing the production and application of the rays. Prof. Röntgen will be present as the guest of honor.

Single-Phase Railway Motors.*

BY FRIEDRICH EICHBERG.

THE standard direct-current railway has probably been developed to its final stage. The combination of alternating current for the transmission of power, rotary converters for the conversion into direct current, and direct-current car motors, is not, however, an economical solution except in rare cases. Recognizing this fact, Brown & Boveri (Burgdorf-Thun) and Ganz & Company (Valtelina line) took up the direct application of polyphase alternating currents. But even if the polyphase system has achieved practical success in special cases, it has not been proven thereby that the polyphase motor furnishes a universal solution of the electric railway problem. It is not necessary here to repeat all the objections that European and American engineers have brought forward in numerous discussions against the polyphase motor. The multiple trolley for the collection of current, which is unavoidable in the polyphase system, leads to complications in the overhead work and sets narrow limits to the line voltage available. For short roads (lines between neighboring cities) the polyphase system, moreover, leads to excessive cost in the installation of the conducting system. Add to this that the polyphase motor, by reason of its characteristic speed curve, which resembles that of a shunt-wound motor, is almost or quite unfit for railway purposes. It cannot be disputed that it is possible to operate on schedule time upon special lines with a favorable profile, but this proves nothing as to the general applicability of the polyphase motor.

For two years, as is well known, efforts have been made to apply the single-phase motor to railway purposes. B. J. Arnold, with his electro-pneumatic system, and the Oerlikon Company, with the Ward Leonard system, offered only incomplete solutions of the

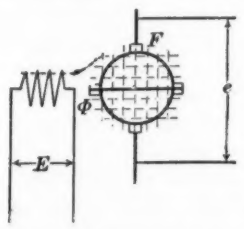


FIG. 1.—DIAGRAM OF WINTER-EICHBERG MOTOR.

problem of applying single-phase current to railways. The first announcement of the direct application of single-phase motors came from Lamme, of Pittsburg, and was followed soon after by the publication of Finzi in Milan. The former used a frequency of 16 and the latter 18 cycles per second. Both have built series motors similar to the direct-current series motor. The former uses, for the compensation of the armature reaction, short-circuited windings, which are applied in the field magnet coils and whose axis coincides with that of the brushes; the latter uses slots in the poles for the diminution of the armature reaction.

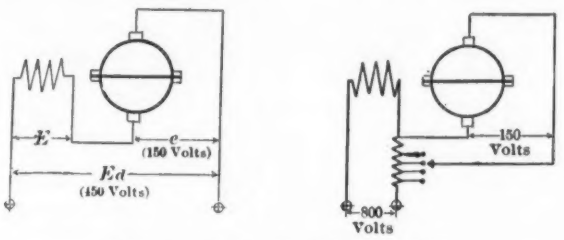
Later the work of G. Winter (see *Elektrotechnische Zeitschrift*, 1904, No. 4), of Vienna, became known to the writer. This furnished the basis of the system worked out by the Union, and especially by the Allgemeine Elektricitäts-Gesellschaft. This system, which forms the subject of this paper, has been put into operation on the Niederschöneweide-Spindlersfeld line under the management of the Royal Prussian State Railway, and on the Stubaital line near Innsbrück, which was opened on July 31, 1904. The first line operates with 6,000 volts and 25 cycles, and the second with 2,350 volts and 42 cycles.

In perfecting this single-phase system the motor of course played the chief part. In a lesser degree the controlling apparatus and those devices which become necessary in the direct application of high tension to the car were also of importance.

In regard to the motor of the Winter-Eichberg system, it unites the properties of the ordinary alternating-current series motor with those of the repulsion motor. Its characteristic features are the following:

In the motor, in addition to its own magnetic field, F, there is developed, as in the repulsion motor, a cross field, ϕ, which, at synchronism, is about as strong as the magnetic field, F, from which it differs in phase by 90°. This means that when the motor is near synchronism a complete rotary field is established, the field being less developed below or above synchronous speeds. On account of the cross-field developed in the motor, the short-circuited e.m.f. under the brushes diminishes with increasing speed, becomes nearly zero at synchronism and then increases again with increasing speed.

In regard to armature voltage, these motors are essentially similar to the ordinary series motor. In both the tension per commutator segment may not exceed a certain value and, according to the size of the motor, the armature voltage will, therefore, lie between 100 and 200 volts. In the ordinary series motor, in which the working voltage appears in the armature, the working voltage would, therefore, not exceed 200 volts. It is otherwise with our motor. Since the armature is short-circuited along the working axis and the working voltage appears only in the stator field windings the voltage supplied to the motor may be as great as desired. But even for the case where the excitation is inserted in series with the stator wind-



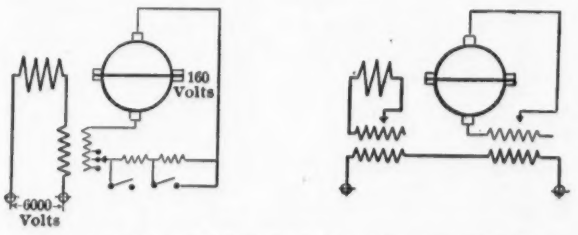
FIGS. 2 AND 3.—STATOR WINDINGS.

ing (Fig. 2), the entire working voltage, E, is in the same proportion to the armature voltage, e, at rest as the entire volt-ampere input is to the volt-amperes for magnetization at rest.

Let us suppose that the magnetizing current is one-third of the armature current, which is a good practical mean; then the working voltage in the motor of our system, even with the direct introduction of the excitation, is three times as high as in the ordinary series motor. Through the insertion of a small transformer (Fig. 3) one can increase at will the proportion of the working voltage to the armature voltage without great expense (Figs. 2 and 3).

The excitation by means of the armature in combination with the cross-field yields an e.m.f. which is 90° ahead of the working e.m.f. and directly opposite to the e.m.f. of self-induction. This wattless counter e.m.f. gives the motor the well-known rapidly rising *cos* curve. (See *Elektrotechnische Zeitschrift*, 1904, No. 4.) Our first 100-hp motor had, with a 3-mm. air space on each side, a power factor of 0.9 even at 70 per cent. of synchronism. Even more important is the fact that this good power factor is obtained with a number of ampere-turns per centimeter almost twice as great as in the ordinary alternating-current motors. From this results the possibility of building a very powerful motor for a given armature diameter and external dimensions.

Another characteristic property of our system is that the field can be controlled independently of the voltage in the working windings. In every alternating-current commutator motor there are magnetic losses in the coils short-circuited by the brushes. Through the possibility of adjusting this field in proportion to the stator cur-



FIGS. 4 AND 5.—DIAGRAM OF METHODS OF CONTROL.

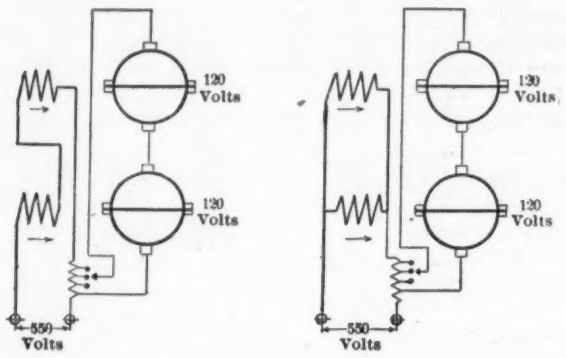
rent, one can keep these losses under the brushes within such limits as will permit the commutator and the brush holders easily to conduct away the resulting heat. By varying the field one can, for a given working voltage, give the motor a variable characteristic. The separate characteristic curves will then be somewhat related as the curves of a 3, 4, 5 and 6-winding motor. Control independent of this naturally is possible and also control of the load voltage. The accompanying diagrams give examples of the control as carried out in practical cases. In Fig. 4 the primary voltage is not regulated and only the secondary winding of the exciting transformer is altered.

The absence of any primary regulation in the high-tension circuit

*A paper presented at the International Electrical Congress.

offers the special advantage that only low-tension circuits will have to be opened or closed when the car is to start, reverse or alter its speed. A still more complete solution is shown in Fig. 5, the stator circuit as well as the exciter circuit being regulated. This method of connection is less advantageously applied to high-tension motors, because the high-tension circuits generally cannot be readily altered in operation.

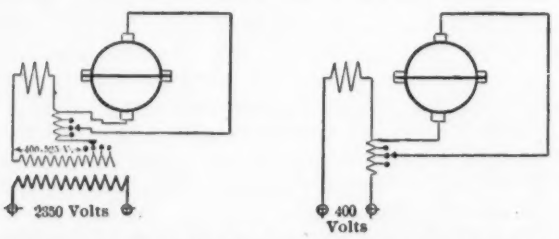
The third diagram (Figs. 6a and 6b) shows a method of control which, although not quite so complete as that of Fig. 5, is yet of value for small low-tension cars, and which will shortly be put into



FIGS. 6A AND 6B.—METHOD OF CONTROL FOR LOW POTENTIALS.

operation on a short Belgian road. The scheme of Fig. 5, with the modification represented in Fig. 7, was installed on the Stubaital line near Innsbrück, now in operation, which is at times operated at 2,350 volts and at other times at 400 volts. The direct insertion of the excitation in the stator circuit (Fig. 2) in which the control is effected by ohmic or inductive resistances with the eventual application of series parallel regulation, is possible for small cars, and hence chiefly applicable to short railway lines. In the latter case the motors can be built simply for 550 volts. Motors for 550 volts connected in this manner are already in operation, and will also run on direct-current lines. (Figs. 7a and 7b.)

The possibility of running an alternating-current motor with direct current is of great importance in practical application. Ordinary series commutator motors, which are built on the compensated sys-

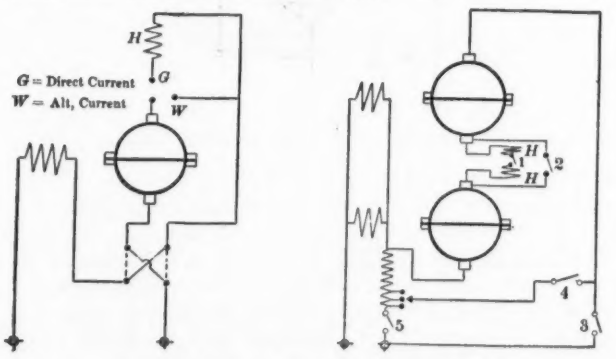


FIGS. 7A AND 7B.—METHOD OF CONTROL ON STUBAITAL LINE.

tem of Deri, can, of course, be run both on direct-current and alternating-current circuits. The voltage for the direct-current motor is 1½ to 2 times higher than the armature voltage with alternating current. Since, as we have shown above, the alternating-current voltage, which in our motor system can be directly applied, may be three times greater than the armature voltage, the ratio of direct-current to alternating-current voltage will be, not as in the series motor, 3 : 1½ or 3 : 2, but 3 : 3 to 1½ or 2; that is, the direct-current voltage will be about half that of the alternating-current voltage. This allows, for example, the running with direct currents with motors connected in series, and with alternating current with the motors connected in series, and with alternating current with the motors connected in parallel, but in the former case at less speed. This corresponds to the case in common practice where cars which travel over interurban stretches at high speed transfer to the direct-current systems of cities, where lower speed is demanded. There are various ways of running, with a motor connected according to Fig. 1, on direct-current circuits. The method which has proved itself most practical is represented in Fig. 8. In the direction of the diameter of the exciter axis a winding is applied which counteracts and opposes the armature ampere-turns. The stator field windings then produce a magnetic field with direct current, and the exciting windings on the armature represent with direct current the working ampere windings. The field saturation in direct-current working is then somewhat greater than with alternating current, while the density in the armature is somewhat less. These properties are extraordinarily favorable for practical operation. The auxiliary winding, *h*, is inserted only when operating with direct current. In order to make better use of the armature, the field windings of two motors can be connected in parallel in the direct-current circuit, while in order to be able to operate at 500-550 volts with direct currents, the armatures can be connected in series. These conditions are represented in Fig. 9. In the altrnating-current system one can operate according to the method of either Fig. 3 or Fig. 6. If operated according to plan 3, then with alternating currents the connections 2, 4, 5 are closed and 1 and 3 are open. With direct current 1 and 3 are closed and 2, 4 and 5 are open.

The motor system which I have above briefly described will not be the only one in the field. I cannot, however, undertake to pass an unbiased opinion upon the different systems possible. I can only briefly mention the reasons why, in my opinion, the alternating-current commutator motor, which has been long known in two general types, namely, the ordinary series motor and the repulsion motor, is not to be considered of equal value to the system above described. The ordinary series motor possesses, even if it is compensated, no cross field; and it has no rotary field. The short-circuit losses under the brushes do not decrease with increasing speed, and the power factor increases much slower with the speed. The maximum working voltage for which it can be built is 200 volts. When a short circuit takes place in the field winding of the series motor, the motor becomes inoperative. Multipolar machines with series windings on the armature, if provided with the device shown in Fig. 1, can have an entire field coil short-circuited without the motor becoming inoperative. The separate field coils behave like transformers inserted in series. Any one of these can always be short-circuited; the others then receive correspondingly more voltage.

The repulsion motor, when contrasted with the arrangement of Fig. 1, has the disadvantage that its reversal is possible only by the application of a second field winding, or of several sets of brushes, or of reversible brushes. Its power factor is poorer, and for its control there remains only either the method of primary



FIGS. 8 AND 9.—MOTOR CONNECTIONS.

voltage control, the opening of short-circuits, or finally of brush reversal.

The disadvantage of the type represented in Fig. 1, as compared with the series and repulsion motor, consists in the employment of two exciter brushes, which doubles the number of brushes in multipolar systems. These exciter brushes give rise to no difficulties with respect to short-circuit losses; as I have shown (*Elektrische Bahnen*, Vol. 2, 1904), these short-circuit losses do not occur with exciter brushes. They carry moreover only one-third to one-fourth of the entire short-circuit current. On the other hand, the motor of Fig. 1, as compared with the compensated series motor and the repulsion motor with the double field winding, offers the constructional advantage of only one field phase, which guarantees good economy and great simplicity. In high-tension motors the increased certainty of operation in consequence of the absence of cross windings must be considered. Motors for either direct-current or alternating-current working, provided with the auxiliary winding, *h*, which plays the part of the compensation winding of the compensated series motor, can, therefore, only be operated advantageously with low-tension alternating currents.

The results of more than a year's operation on the 6,000-volt Niederschöneweide-Spindlersfeld line, on which during a great part of the day four 100-hp motors haul a 160 to 170-ton train, and on which daily two motors handle a 100-ton train, prove that the alternating-current motor is adapted to the heaviest traffic. Moreover

the direct application of 6,000 volts to the car has been demonstrated to be entirely safe.

The Stubaital line, which has been running since July 31, 1904, at 42 cycles and 2,350 volts, has introduced an advanced practice for small roads, an advance which exceeds the boldest expectations of the year 1902. At that time it seemed as though only very low frequencies could be used. In the case of many roads running in connection with existing power stations operating with 40-50 cycles, the possibility of using these frequencies limits the availability of alternating-current traction. Moreover, the possibility of operating also with direct current makes the alternating-current commutator motor in a certain sense a universal motor, and places it, as regards its main features, far above the direct-current commutator motor, which really represents only a special case of the alternating-current commutator motor.

The Interstate Independent Telephone Convention.

IN the ELECTRICAL WORLD AND ENGINEER was given last week by telegraph the first two days' proceedings of the fourth annual convention of the Interstate Independent Telephone Association, which met in the banquet hall of the Auditorium Hotel at Chicago, December 13, 14, 15. As stated in the previous account, the first meeting was called to order by President Barnhart.

Before proceeding with the regular programme the matter of credentials and admissions to the hall was considered. Secretary Coleman suggested that a credential committee of three be appointed to assist the secretary in passing upon credentials. A motion to this effect by Mr. F. J. Goodwine being passed, Mr. W. Mathews, of Kentucky, Mr. P. C. Holdegel, of Iowa, and Mr. William R. Fee, of Ohio, were appointed on the committee. Upon a motion by Mr. Holdegel, the resolution passed at the preceding convention barring from the meeting all those not holding credentials was so changed as to make all but the executive sessions open to the public.

The president then delivered the annual address. He referred, as already noted, to the effects of organization in the independent telephone field. Before organization, he said, the disconcerted bands tried to avoid contact with the Bell interests. The field, he said, had been extended until it embraced nearly all of the great cities. Chicago, however, was not connected. The question as to whether this was due to lack of appreciation on the part of the city or lack of determination on the part of independent telephony, he left to the convention. Referring to the programme, he observed that the papers to be discussed were by men of broad intelligence and that the topics were of vital interest to all. Most important of all he considered those which raised a warning against trusting manufacturers who would betray them for a trifle. By using Bell-made apparatus and by subscribing for independent telephone periodicals which printed Bell advertisements, independent people were only strengthening the enemy. He urged caution. In conclusion, he hoped that even greater achievements than had been accomplished in the past were possible in the future.

Secretary Coleman, in his annual report, said that the time had arrived when definite action should be taken along the lines indicated in the report of 1903. He referred to the three methods of attack upon independent telephony by the Bell. (1) By securing control of the central one of a cluster of independent companies. (2) By securing control of the long-distance business. (3) By securing the controlling influence in the independent manufacturing interests. In the past the conventions had simply discussed the questions put before them. Nothing definite had been accomplished. But the reports to be given of the several important committees appointed at the last convention, he said, would be a revelation and would prove that the right men had been selected to serve on these committees. It could no longer be said that the convention was merely a debating society. Mr. Coleman referred at some length to attempts by certain manufacturing concerns to kill the interstate association. More than a year ago, he stated, effort had been made to demoralize or destroy the effectiveness of the organization. These attempts were a failure. A later attack was made, he said, by instituting a boycott to prevent those manufacturing concerns located outside of Chicago from making exhibits at the convention, with the intention of thereby crippling the association financially and ultimately causing its annihilation.

Concerning the growth of the independent telephone movement, he said there were in the country over 3,000,000 independent telephones in service, while the Bell claimed but 1,270,000. At the beginning the phenomenal growth was largely due to the feeling of resentment by the people against the Bell and the opportunity offered for relief by the independent movement. The question of rates assisted as the Bell at first refused to cut. But now, since the Bell was making equal and sometimes lower rates, the basis of competition would hereafter be based on the efficiency of the service rendered.

George N. Bandy, of Iowa, chairman of the express committee, when the reports of the committee were called, stated that inquiry had developed the fact that express companies were now in most cases paying their telephone rentals.

Secretary Coleman reported that he and some of his associates had outlined a plan for the consolidation of the Interstate Association with the National Association. He then read the minutes of a conference of representatives of the two associations which met at the Auditorium Hotel Friday, November 18, 1904. At this conference James B. Hoge, J. G. Splane and E. L. Barbour, of the National Association, and E. M. Coleman, Charles E. Hull and Henry A. Barnhart, of the Interstate Association, were present. The Interstate representatives had no power to act. Statements read by Messrs. Coleman and Hoge showed the necessity of effecting a combination. The conference, before adjournment, adopted a resolution to the effect that all matters discussed at the conference be kept a profound secret, and that no further steps be taken toward the organization of district associations under the plan mapped out by the National Association until the next convention of the Interstate Association. At this present convention the appointment of five men was to be recommended to meet in joint conference with five representatives of the National Association. These ten men were to be empowered to effect a permanent organization of the two associations.

This concluded the business for the opening session and the president took occasion to remark upon the auspicious opening of the convention, saying that never before had so many been in attendance at the first meeting. He also read the programme for Wednesday, December 14, and urged upon those present eligible to membership who had not already joined to do so, that they might get the full benefit of the executive sessions as well as the open ones. Were the National Independent Association and the Interstate Association consolidated, the membership in the Interstate would be carried forward and none of its privileges be abridged.

Secretary Coleman read an invitation extended by the American Steel & Wire Company, through its general sales agent, Mr. F. Baaches, to the association, to visit its works at Waukegan and witness the making of telephone wire on Thursday. The invitation was unanimously accepted. The meeting was adjourned until 4 o'clock, when the association went into executive session.

In opening the executive session, President Barnhart stated that the meeting was held to consider the proposition made for a consolidation of the two associations. Senator Hull thereupon offered the following resolution: "Resolved, that the chairman of the association appoint a committee of five, himself included, to meet a like committee from the National Association, to consider ways and means to consolidate, with power to act and with the proviso that the ownership of the Interstate Association be continued in the consolidated association, with all their rights and privileges." After considerable discussion this resolution was amended so that this committee of five should consist of President Barnhart, the newly elected president, the newly elected secretary, and two other members to be appointed by President Barnhart. With this amendment, the motion was passed. The convention was then adjourned until 2 o'clock, Wednesday.

The meeting on Wednesday afternoon was called at 2.45 o'clock by President Barnhart, who directed attention to the programme for the afternoon. He stated that Mr. O. M. Bake, Hamilton, Ohio, who was to have prepared a paper, "Why Independent Telephone Securities Do not Command the Market Price They Deserve According to Their Earning Capacity," had been too ill, either to prepare the paper or to be present.

Mr. Theodore Thorward then presented a paper: "What the Independent Telephone Companies Owe the Public. What the Public Owes the Independent Telephone Companies." He stated that all owners of public franchises have distinct duties placed upon them and it depends upon how well they perform these duties whether or not they can retain the favors they have received. The

Bell Company had had the greatest opportunity ever presented to a corporation. Instead of doing its duty to the people, it placed its rates so high as to serve only a few, and, to retain its business, relied upon its patent rights. At the inception of the independent telephone movement, the people, seeing relief from the treatment accorded them by the Bell Company, turned to the independent people, notwithstanding the fact that poorer service was obtained. But now the people knew that the independent companies could give good service, and unless it was given them these companies would no longer retain public favor. In addition to good local service, the independent people also owed their patrons good toll line connections. However, connections between San Francisco and New York and like distances were not demanded, because not more than 3 per cent. of the subscribers ever had occasion to use such service. The majority did demand service in the surrounding counties, and it was the duty of the companies to provide this service. The telephone department of the Illinois Tunnel Company, if an independent one, owed it to their subscribers as well as to all independent companies to connect with the surrounding systems. By refusing to do so, he said, they were cheating the independent companies out of thousands of dollars of toll line money annually. If the telephone company gave good service, it was the duty of the public to be willing to pay a fair rate for the service. Should experience prove that a company had permitted a too low rate clause in its franchise, it was no more than right that the public be willing to correct the error. Another duty of the public to the company was that all bills be paid promptly and thus avoid the employment of extra collectors with the added expense.

President Barnhart invited free discussion of the paper. He stated that the value of the papers was as much in the ideas suggested to those who listened as in the ideas of the ones who presented the paper. Mr. Presson, of Iowa, wanted to know if there was anyone in the hall who had made application to the Illinois Tunnel Company for connection and had been refused. Mr. Conklin, of Aurora, Ill., stated that his company had made application for a connection and had offered to build a subway, if necessary, from the city limits to the tunnel, to make the connection. A permit to do so, however, had never been granted them. The company had never refused his request, but at the same time the treatment accorded him was rather discouraging.

Mr. Richmond, of Wisconsin, wanted to know if there was any hope of outlying districts being connected with the centers of trade in the immediate future. He said that in his own State they had probably as good toll lines as existed, but that there was no unity among the exchanges. He could not see hope for immediate satisfactory independent toll service. Mr. Valentine, of Wisconsin, explained that Mr. Richmond's question was occasioned by the fact that his company had recently received overtures from the Bell Company for toll service connection. He said that Mr. Richmond had attended the convention mainly to find out whether or not it would be advisable to make such connection. He added that the independent people should not expect to accomplish in five years in toll connection what it had taken the Bell Company twenty-five years to accomplish. Mr. Richmond admitted Mr. Valentine's statements, saying that his stockholders, notwithstanding the fact that they were imbued with the independent spirit, rather favored making the connections because of the superior toll service that could be obtained. An animated discussion followed. Mr. Thompson, of Ohio, said that the independent field was building rapidly, and it was only a question of a few years until satisfactory independent toll lines would be obtained. Mr. Loesch thought that if in 1894 and in 1900 the independent telephone people were able to battle against the Bell, they should certainly continue the fight now, and he said that the stockholders in Mr. Richmond's company should be encouraged to wait a year or two longer.

"Manufacturer's Duties and Their Dues," was the subject of the next paper presented by E. D. Graham, president of the Mexico Telephone Company, Mexico, Mo. Mr. Graham said that in the last few years there had sprung up a number of concerns manufacturing independent telephone apparatus that was as good as the best, and that he believed it the duty of the independent people to encourage the independent factories as far as possible. If the enemies of independent telephony obtained possession of the factories, the independent operators would suffer greatly because of the inability to get good apparatus. The duties of the manufacturers demanded that they produce and sell the very best of apparatus, and that they show their loyalty to the business and interests of the men to whom they sold their products. It was certainly their duty to protect the people to whom they sold apparatus rather than to undertake to organize mutual concerns to sell their products. If all the manufacturers had recognized the importance of performing their duties to the operator and had performed them loyally and faithfully they would to-day have had the loyal support, confidence and backing of all operators in the independent field.

At the conclusion of Mr. Graham's paper Mr. E. L. Barbour moved that a committee be appointed to wait upon Mr. Wheeler, of the Illinois Tunnel Company, and report at the next session as to what prospects there were for independent telephone companies obtaining connection with the company's telephones. Messrs. Barbour, Veneer and Thorward were appointed on the committee.

The paper entitled "Uniformity of Equipment and Standardization the Imperative Demand in the Operating Field" was then presented. Owing to the illness of Mr. J. H. James, of Minnesota, who had prepared the paper, it was read by Mr. John E. Jones, of Jonesboro, Ark. At first thought, he said, it would seem that to standardize the entire equipment of the independent field would entail a prohibitive expense. However, this expense would be offset by future maintenance, since one-half of the sales made by the manufacturers to-day are for improved devices made necessary by progress. He urged that in rebuilding outside construction it be standardized and so constructed as to place the properties on a par with the best. Mr. Bellamy, in discussing the paper, said standardization meant the death of improvement. Standardization was not wanted, but instead the best telephone equipment that could be made was demanded. Mr. F. W. Ellis thought that standardization of instruments meant the selection of switchboard, telephone and toll line apparatus that would work together. Mr. Thompson said that if the manufacturers were asked for standard equipments and later were able to give better than the standard, the operator owed it to the people to adopt the better apparatus, and that standardization would never be arrived at as long as improvements continued.

Wednesday's session was called to order at 9.30 by President Barnhart. A nominating committee was first appointed consisting of Mr. Reeves, of Indiana; Mr. Lichty, of Iowa; Mr. Graham, of Missouri; Mr. Hull, of Illinois; Mr. Mathews, of Kentucky; Mr. Harper, of Wisconsin, and Mr. Fee, of Ohio. The committee appointed having retired President Barnhart announced that ten or fifteen minutes would be devoted to the discussion of "Why Independent Telephone Securities Do not Demand the Market Price They Deserve According to Their Earning Capacity." Mr. W. G. Thompson, of Ohio, said that the financiers were not educated to the needs of the hour. The only place where securities could be floated successfully was with the people who had confidence in the plan, in the business institution, or in the individuals composing the institution, and these were usually local people. The president then announced that, because of the small number of tickets purchased for the banquet it would be necessary to forego the pleasure afforded by giving one, as the executive committee did not feel warranted in assuming the necessary expense.

"How to Avoid Personal Injury and Responsibility Therefor in Telephone Construction and Maintenance" was the subject of a paper presented by Senator Rome C. Stephenson. In his paper Mr. Stephenson said that it was impossible to lay down a set of rules to govern a telephone company which, if faithfully followed, would avoid responsibility for personal injuries. There were, however, a number of safeguards and precautionary measures that should always be followed whereby the liability to accident would be reduced to a minimum. A large percentage of the injuries sustained by linemen were the results of falls received through defective cross arms. When the defect in a cross arm was easily discernible, the liability of the company was less than if it were an invisible defect, since, in the former case, the person injured is partly at fault for lack of observation. In the construction and extension of telephone lines, extraordinary care should be taken where the lines cross high-voltage systems, and in such case a space of at least 4 ft. should be allowed between the two lines. The dead telephone line was always one of danger and should always be disconnected from a building and securely fastened out of reach. In conclusion, he said that it was only by unusual vigilance and care that telephone lines could be constructed so as to reduce responsibility for personal injuries to a minimum. Mr. Stanton, in discussing the paper, thought that a small accident insurance should be carried by telephone companies to protect them from heavy damages. Mr. Johnston, of Michigan, thought that the liability of in-

dependent telephone companies in case of accident was increased by the employment of cheap men. He urged that the competent men be employed, that they be paid good wages, and that the company insist on good work.

The committee appointed the previous day to wait upon Mr. Wheeler, of the Illinois Tunnel Company, reported through its chairman, Mr. Barbour, of Illinois, that they had had a very pleasant interview with Mr. Wheeler, who stated that as soon as the representatives of the Interstate Telephone Company could give him assurance of standard construction for any given number of telephones, he was willing to make connection within a period of from three to six months. He would not, however, make a contract without definite knowledge. Mr. E. R. Conklin was added to the committee appointed to interview Mr. Wheeler, and the committee was continued for the purpose of presenting to Mr. Wheeler, the Interstate Telephone Company as one employing standard construction, and ready to be connected to the Chicago system.

In the absence of Chairman L. L. C. Brooks, Secretary Coleman read the report of the committee appointed the previous year to confer with the late Postmaster-General Payne. The report stated that Mr. Payne acknowledged he was responsible for the instructions sent out, "that but one telephone system should be used in all post-offices and that system must be the one that had long-distance connection with Washington." Through the committee pressure was brought to bear upon Congress, resulting in an amendment to the post-office appropriation bill to the effect that no part of the appropriation be expended for telephone service in any post-office where the postmaster was required to use the Bell telephone alone. The amendment, however, failed to pass the United States Senate. The result of the fight put an end to the removal of independent telephones from post-offices, and in addition gave a more general knowledge of the independent telephone movement.

A committe, with Mr. Barbour as chairman, was appointed to audit and to arrange for the payment of the accounts incurred by the committee which investigated Postmaster-General Payne's order. The report of Treasurer A. B. Conklin, as read by Secretary Coleman, showed that during the year $409.01 had been received, all of which had been expended. Secretary Coleman stated that, in addition to this, he had expended out of personal funds about $800.

Upon a motion of Mr. Theodore Thorward, the committee appointed to confer with the Illinois Tunnel Company was increased by two members from each State covered by the Interstate Telephone Association to constitute a committee to gather information concerning toll lines for the information of the Chicago Tunnel Company.

At 11.20 o'clock the convention went into executive session and the report of the nominating committee was called. The report was as follows: President, Theodore Gary, of Macon, Mo.; vice-president, William R. Fee, Milford, O.; secretary, L. L. C. Brooks, St. Paul, Minn.; treasurer, A. B. Conklin, Aurora, Ill. The executive board recommended consisted of Hon. C. E. Hull, Salem, Ill.; S. S. Lichty, Clinton, Iowa; J. G. Splain, Pittsburg, Pa.; Richard Valentine, Janesville, Wis.; W. Mathews, Maysville, Ky.; E. D. Graham, Mexico, Mo.; Charles W. Wells, Marion, Kan.; H. A. Barnhart, Rochester, Ind.; W. Gray Jones, Columbus, O.

A resolution of thanks to the retiring president and secretary was also incorporated in the report of the nominating committee. The report was unanimously adopted. After the appointment of Mr. Gary, Mr. Brooks, Mr. Coleman, Mr. Hull and Mr. Barnhart on the committee to arrange for the consolidation of the two associations, the convention adjourned.

Census Reports on Electricity.

In his report to the Secretary of Commerce and Labor, on the operations of the Bureau of the Census for the year 1903-4, Hon. S. N. D. North, director of the bureau, says: "The division of manufactures, Mr. William M. Steuart, chief statistician, is engaged in completing a series of important reports upon the electrical industries. These reports are four in number, and cover street and electric railways, the complete report upon which subject is in the hands of the printer; electric light and power plants, upon which a final bulletin has been published; municipal electric fire alarm and police patrol systems, already published in bulletin form, and telegraphs and telephones, upon which a bulletin is now in preparation. This series of reports is to be assembled in one quarto volume. Together they present a complete account of the remarkable development of the electrical industry, in its application to public utilities. Nothing so rapid, so striking, and so revolutionary in its effects upon private manufacturing and public convenience, as the application of electricity to power and lighting purposes, has been witnessed in industrial history. So marked are the improvements made and the new uses to which electricity is applied that changes in the statistics of these industries arise during the brief period that elapses between compilation and actual publication. The relation of these industries to the economic and social welfare of the country is so intimate, and is daily becoming so much more important, that I recommend that Congress be asked to authorize new inquiries at dates five years subsequent to those covered, instead of waiting for the decennial period, as originally contemplated by the census law."

New Telephone Exchange at Somerville, Mass.

The New England Telephone & Telegraph Company has recently completed a new telephone exchange building in Somerville, Mass., at the corner of Bradley and Pearl Streets. Increasing business in this territory led to the seeking of new and enlarged quarters, and the office was opened for the handling of traffic in the early part of September. Somerville is a suburban city of about 70,000 people, lying some three to four miles north of Boston. It is largely a residence town, although the business and residence telephones are about evenly divided. It lies within the Boston district of the New England Company and has free trunking to practically all the cities and towns in the suburban territory of the district. Practically all the local service furnished by the new exchange is that of Somerville, although a few subscribers are located in one or two adjoining towns.

The new building is two stories in height, with a basement partly above and partly below the ground. It is of the mill type of construction, the walls being of cream-colored pressed brick. The building occupies an area 60 ft. long by 41 ft. 10 in. wide. The basement is divided into a power and terminal room, a battery room and a heating and storage space. On the first floor are the retiring room for operators and the prospective quarters of the construction and maintenance departments of Somerville, Charlestown and Cambridge. In the hallway of the first floor is a pay station set for public use. The second floor contains but one room—the operating quarters of the exchange. This room is built without a single post and is laid out to enable the present "A" or local subscribers' board to be extended to a total of 15 sections around three of the walls. The "B" or incoming trunk board may likewise be expanded to a total of seven sections.

Passing through the west wall of the basement the subscribers' lines enter the power and terminal room in the form of lead-covered cables, which are brought to the main distributing frame. At present there are two 360-pair and seven 180-pair cables entering the building. In harmony with the usual features of Bell telephone practice, the main frame is of the Western Electric Company's make, as are the intermediate distributing frame, the main switchboard, relays, coils, etc. The main frame has a capacity of 10 horizontal shelves, with 360 pairs or lines per shelf and 18 arrester bars on the vertical side with 160 pairs of arresters per bar. There is also a terminal bar with a capacity of 200 pairs of terminals. The present equipment of the main frame consists of 180 terminal strips on the horizontal side, 1,340 pairs of arresters and 200 pairs of terminals on the vertical side. The main frame is 12 ft. 6 11/16 in. long and 34¼ in. wide. It may be extended to enable 27 more arrester bars to be added toward the east as the business of the exchange develops. The intermediate frame has a capacity of nine shelves on the horizontal side with 800 lines per shelf, and on the vertical side 40 bars with 180 lines per bar. At present the horizontal side is equipped with 66 and the vertical side with 75 terminal strips. Between the main and intermediate frames is the relay rack, having a total capacity of 16,800 relays and a present equipment of 2,490. Beyond the intermediate frame is the repeating coil rack with an ultimate capacity of 1,377 coils and 660 condensers. After leaving the terminal room, the circuits are run to the operating room in flat cables by means of a vertical cable shaft located in the north wall. This shaft is equipped with doors on the first floor, so that it may be easily inspected.

Current for talking and signaling purposes is supplied by two storage batteries of 11 cells each, set up in a battery room 14ft.

long by about 9 ft. wide, on the basement floor. The larger battery is made up of 13 plate Chloride accumulators of the Electric Storage Battery Company's type G-23 cells, and it is used for local traffic. The smaller battery is composed of E-11 cells and is operated in series with the larger one in long-distance conversations. That is, 24 volts is the potential used in local and 48 volts that used in toll service. Each battery is charged by a 30-volt Western Electric, six-pole, 225-amp. generator driven at 1,120 r.p.m. by a White & Middleton gas engine, rated at 12 brake hp. The gas engine exhaust is carried up through the walls to the roof, special care being taken to avoid fire risk. The cooling water tank for the gas engine is located in the heating and storage space in the basement. The generator is set on brick and wooden foundations 2 ft. 11 in. square. A duplicate charging set is located near the gas engine on a foundation 5 ft. 10 in. by 3 ft. 4 in. It consists of a Westinghouse type C 15-hp, three-phase, 60-cycle, 550-volt induction motor, which drives a dynamo of the same type as that run by the gas engine. The induction motor draws its current from the Edison mains through a controlling switchboard and fuse panels mounted in the southwest corner of the power room. The power switchboard is 6 ft. 6 in. long and controls the battery charging and the motors which operate ringing, signaling and test machines. These special machines are mounted on a stand near the gas engine, and include a "howler" or high-frequency interrupter used to call a subscriber's attention when the receiver at his station is left off its hook. The fuseboard is of standard construction, and is located near the coil rack. A two-position test table for inspectors and trouble men's use, 6 ft. long and 21⅞ in. wide, stands near the power switchboard.

The building is lighted by both gas and incandescent lamps, and is heated by two Crescent hot water heaters. The operators' retiring room is supplied with steel lockers, hot and cold water, a gas stove, lunch table, dishes, knives, etc. The operating force includes 17 employes and the night traffic is handled by two men between 10 p.m. and 7 a.m.

Eight positions are at present in use on the "A" switchboard in the operating room, but 12 positions are equipped for service. The board is a No. 1 relay common battery multiple lamp signal Western Electric switchboard at present equipped with 1,000 lines. The maximum capacity of the board is 9,600 lines, all of which are multipled at each position. There are at present in use 642 subscribers' lines serving 1,484 subscribers. It will be seen that ample capacity for growth is provided. There are 92 outgoing and 95 incoming trunks. The trunk multiple has a capacity of 600 and an equipment of 200 outgoing jacks on the "A" board, and a capacity of 240 and an equipment of 140 incoming jacks on the "B" board.

Both the "A" and "B" boards are equipped with a supervisor's circuit by which any operator who wishes to talk with the supervisor plugs into a jack in the multiple, lighting a pilot lamp and operating a buzzer in her section. The supervisor then plugs into a jack in the front of the keyboard and telephones to the operator who wanted her, even though the supervisor may be standing directly beside the operator in question. This arrangement has now become standard practice, and it obviates the necessity of an operator's turning around and taking her attention away from the switchboard, with the resulting increase in the length of time required to answer her calls. There are two lamps and one buzzer on each supervisor's section, devoted to this purpose. The jacks are No. 92 Western Electric and are now standard for this type of board. They are much smaller than the jacks used on earlier central energy switchboards.

The service classification of the "A" switchboard runs as follows: flat rate and mixed; inward ring-down trunks connected with all the suburban and smaller metropolitan exchanges; flat rate; nickel slot telephones and pay stations; full measured Boston and suburban service; suburban measured service (10 cents to Boston); inspectors' or trouble position. The "B" board, which handles incoming trunk traffic, has a capacity of four and an equipment of three positions. The first position takes care of toll service, information lines and service testing; the second handles incoming trunks from Charlestown, Brookline, Oxford and Cambridge exchanges, while the third looks after the incoming trunks from Boston main, Haymarket and Roxbury.

The manager's desk is located in the southwest corner of the operating room, and from it everything which goes on can be readily seen. It is connected with the "A" board by two lines, and has one line to the chief operator, one to the information table and one to the wire chief. Access to the operating room from the first floor is had by a stairway terminating near the center of the room. Near this stairway is located the chief operator's desk. It is equipped with lines to the "A" and "B" boards, information table and manager, and also has jacks devoted to service inspection. The manager's clerk occupies one side of this desk, which is equipped with a duplicate turret of jacks, with the exception of the service, observing or inspection jacks. The information table is equipped with nine inward lines from the "A" and "B" boards, five outward lines to the first position "B" operator, two outward lines to the "A" board and one line each to the inspector, chief operator and manager. The service can also be observed and the operators' head telephones reached by this table. One supervisor at present looks after the service in the operating room and the busy hour comes in the morning, from 8.30 to 10 or 10.30 a.m. On the "B" board is located an arrangement of flash-back signals, which notify the "A" operator of an outside exchange whether a desired line in the Somerville exchange is busy or out of order. This signal is transmitted over the designated trunk and flashes the "A" operator's "B" subscriber's supervisory lamp, according to the condition of the Somerville line.

Special care has been employed in the Somerville office to reduce the fire risk. Badger chemical extinguishers, asbestos blankets and dogskin gloves to enable the switchboard cables, etc., to be handled when fire is present, are placed in convenient locations on each floor. The soldering iron shelves are also covered with metal supports, and dry powder extinguishers are hung at frequent intervals. The main switchboard will shortly be equipped with fire-proof barriers between the cord shelf and the multiples. Completely equipped, the building cost about $65,000. The manager in charge is Mr. E. F. Hersey.

Lectures on Central Station Work at the Brooklyn Polytechnic Institute.

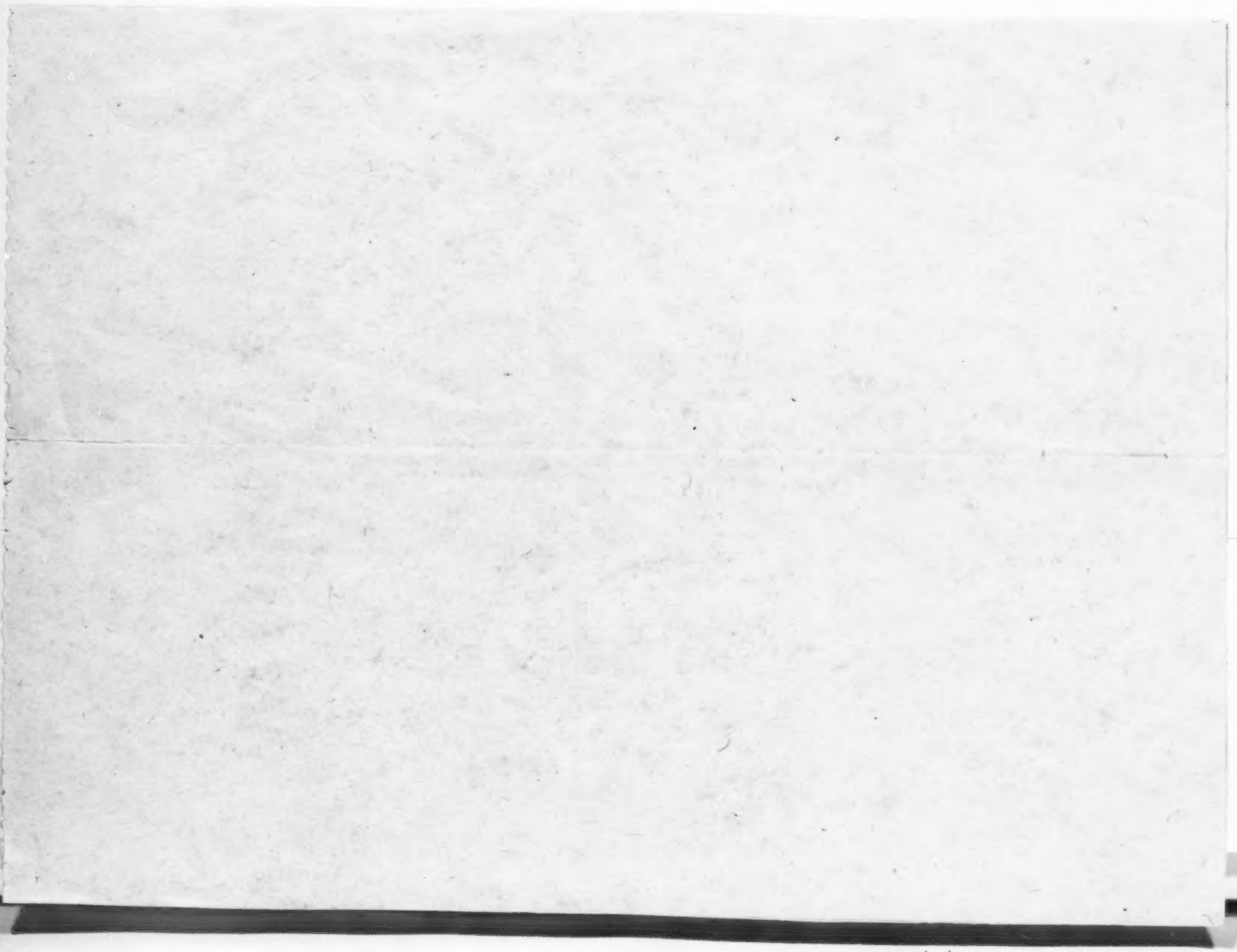
The new course in electrical engineering at the Brooklyn Polytechnic Institute was inaugurated December 15 by Mr. W. S. Barstow, who delivered the first of a series of eight lectures on central station practice. As has been noted in these columns, this is one of a number of branches in electrical engineering which will be similarly covered by authorities in the respective branches, who have been added to the staff of the Polytechnic as consulting professors. The subject of Mr. Barstow's lecture was "Local Conditions Governing the Selection of the System." The speaker took up in detail the preliminary determinations which a consulting engineer should make before recommending and laying out a central station for lighting and power work, such as determining the character of the community, its past and probable future growth, franchise conditions, the location of the station with reference to fuel and water supply, cost of labor, etc. The lecture was extremely interesting, since it was really devoted to a practical consideration of some of the problems which the consulting engineer must meet in everyday work.

Perhaps no better idea can be given of the character of this course than by publishing the eight questions which Mr. Barstow prepared and gave out at the end of the lecture. It will be seen that they are all of a strictly practical character, and the work required to solve any of them cannot help being of value to the student, while giving him the proper training for consulting engineering work. All replies are required to be made on a standard form of report, such as is used by prominent engineering firms. The questions were as follows:

1, Cost of freight rates to capitals from Schenectady and Pittsburg; 2, cost of economical fields in capitals of United States; 3, accuracy and depreciation of recording wattmeters; 4, cost of various grades of labor in the capitals of the United States; 5, cost per lineal foot vitrified tile four-conduit under cobble, granite and asphalt pavement in New York and vicinity; 6, paper vs. rubber insulation for standard three-phase, three-conductor, alternating-current, 25-cycle, 6,600-volt systems; 7, first cost, cost of operation and methods of handling coal; 8, cost of relative merits of poles for carrying overhead conductors.

Locating Faults in Electric Cables.

In the "make-up" last week a couple of errors crept in in Mr. Fisher's article on "Special Methods for Locating Faults on Electric Cables" (page 1045). The first word should have read "most," not "cost." On page 1046 the 5th line under Fig. 5 was displaced. It should have appeared immediately under the caption.



THE ELECTRICAL WORLD AND ENGINEER'S

MOONLIGHT TABLES FOR 1905

COMPILED BY H. W. FRUND

These schedules are made up on local mean time. Where standard time is used, and it varies considerably from sun time, the proper deduction or addition must be made.

JANUARY, 1905

TABLE No. 1. Frund's Moonlight System.

Date.	Light.	Date.	Exting.
1	5.15 P.M.	2	3.55 A.M.
2	5.15 "	3	5.00 "
3	5.15 "	4	5.00 "
4	5.15 "	5	6.00 "
5	5.15 "	6	6.00 "
6	5.15 "	7	6.25 "
7	5.20 "	8	6.25 "
8	5.20 "	9	6.25 "
9	5.20 "	10	6.20 "
10	5.20 "	11	6.20 "
11	5.20 "	12	6.20 "
12	5.25 "	13	6.20 "
13	5.25 "	14	6.20 "
14	5.25 "	14	12.00 M.
15	12.40 A.M.	15	6.20 A.M.
15	5.25 P.M.	15	12.00 M.
16	1.35 A.M.	16	6.20 A.M.
16	5.25 P.M.	16	12.00 M.
17	2.35 A.M.	17	6.20 A.M.
17	5.30 P.M.	17	12.00 M.
18	5.30 "	18	12.00 "
19	5.30 "	19	12.00 "
20	5.30 "	20	12.00 "
21	5.35 "	21	12.00 "
22	5.35 "	22	12.00 "
23	5.35 "	23	12.00 "
24	5.35 "	24	12.00 "
25	5.40 "	25	12.00 "
26	5.40 "	27	12.40 A.M.
27	5.40 "	28	1.50 "
28	5.40 "	29	2.55 "
29	5.45 "	30	3.55 "
30	5.45 "	31	4.55 "
31	5.45 "	1	5.50 "

TABLE No. 2. Standard Moonlight System.

Date.	Light.	Date.	Exting.
1	5.15 P.M.	2	3.55 A.M.
2	5.15 "	3	5.00 "
3	5.15 "	4	5.00 "
4	5.15 "	5	6.00 "
5	5.15 "	6	6.00 "
6	5.15 "	7	6.25 "
7	5.20 "	8	6.25 "
8	5.20 "	9	6.25 "
9	5.20 "	10	6.20 "
10	8.50 "	11	6.20 "
11	9.45 "	12	6.20 "
12	10.45 "	13	6.20 "
13	11.40 "	14	6.20 "
14	—	—	—
15	12.40 A.M.	15	6.20 A.M.
16	1.35 "	16	6.20 "
17	2.35 "	17	6.20 "
18	3.35 "	18	6.20 "
19	No light.	19	No light.
20	No light	20	No light.
21	No light.	21	No light.
22	5.35 P.M.	22	8.00 P.M.
23	5.35 "	23	9.10 "
24	5.35 "	24	10.20 "
25	5.40 "	25	11.30 "
26	5.40 "	27	12.40 A.M.
27	5.40 "	28	1.50 "
28	5.40 "	29	2.55 "
29	5.45 "	30	3.55 "
30	5.45 "	31	4.55 "
31	5.45 "	1	5.50 "

FEBRUARY, 1905

TABLE No. 1. Frund's Moonlight System.

Date.	Light.	Date.	Exting.
1	5.45 P.M.	2	6.10 A.M.
2	5.50 "	3	6.10 "
3	5.50 "	4	6.10 "
4	5.50 "	5	6.10 "
5	5.50 "	6	6.05 "
6	5.50 "	7	6.05 "
7	5.55 "	8	6.05 "
8	5.55 "	9	6.05 "
9	5.55 "	10	6.05 "
10	5.55 "	11	6.05 "
11	6.00 "	12	6.00 "
12	6.00 "	13	6.00 "
13	6.00 "	13	12.00 M.
14	1.15 A.M.	14	6.00 A.M.
14	6.00 P.M.	14	12.00 M.
15	2.15 A.M.	15	5.55 A.M.
15	6.05 P.M.	15	12.00 M.
16	6.05 "	16	12.00 "
17	6.05 "	17	12.00 "
18	6.05 "	18	12.00 "
19	6.10 "	19	12.00 "
20	6.10 "	20	12.00 "
21	6.10 "	21	12.00 "
22	6.10 "	22	12.00 "
23	6.15 "	23	12.00 "
24	6.15 "	25	12.45 A.M.
25	6.15 "	26	1.50 "
26	6.15 "	27	2.50 "
27	6.15 "	28	3.45 "
28	6.20 "	1	4.45 "

TABLE No. 2. Standard Moonlight System.

Date.	Light.	Date.	Exting.
1	5.45 P.M.	2	6.10 A.M.
2	5.50 "	3	6.10 "
3	5.50 "	4	6.10 "
4	5.50 "	5	6.10 "
5	5.50 "	6	6.05 "
6	5.50 "	7	6.05 "
7	5.55 "	8	6.05 "
8	5.55 "	9	6.05 "
9	9.30 "	10	6.05 "
10	10.25 "	11	6.05 "
11	11.20 "	12	6.00 "
12	—	—	—
13	12.20 A.M.	13	6.00 A.M.
14	1.15 "	14	6.00 "
15	2.15 "	15	5.55 "
16	3.10 "	16	5.55 "
17	4.00 "	17	5.55 "
18	No light.	18	No light.
19	No light.	19	No light.
20	6.10 P.M.	20	8.00 P.M.
21	6.10 "	21	9.10 "
22	6.10 "	22	10.25 "
23	6.15 "	23	11.35 "
24	6.15 "	25	12.45 A.M.
25	6.15 "	26	1.50 A.M.
26	6.15 "	27	2.50 "
27	6.15 "	28	3.45 "
28	6.20 "	1	4.45 "

MARCH, 1905

TABLE No. 1. Frund's Moonlight System.

Date.	Light.	Date.	Exting.
1	6.20 P.M.	2	5.20 A.M.
2	6.20 "	3	5.35 "
3	6.20 "	4	5.35 "
4	6.25 "	5	5.30 "
5	6.25 "	6	5.30 "
6	6.25 "	7	5.30 "
7	6.25 "	8	5.25 "
8	6.25 "	9	5.25 "
9	6.30 "	10	5.25 "
10	6.30 "	11	5.20 "
11	6.30 "	12	5.20 "
12	6.30 "	13	5.15 "
13	6.30 "	14	5.15 "
14	6.35 "	14	12.00 M.
15	1.00 A.M.	15	5.15 A.M.
15	6.35 P.M.	15	12.00 M.
16	1.50 A.M.	16	5.15 A.M.
16	6.35 P.M.	16	12.00 M.
17	6.35 "	17	12.00 "
18	6.35 "	18	12.00 "
19	6.40 "	19	12.00 "
20	6.40 "	20	12.00 "
21	6.40 "	21	12.00 "
22	6.40 "	22	12.00 "
23	6.45 "	23	12.00 "
24	6.45 "	24	12.00 "
25	6.45 "	26	12.40 A.M.
26	6.45 "	27	1.40 "
27	6.50 "	28	2.35 "
28	6.50 "	29	3.20 "
29	6.50 "	30	4.00 "
30	6.50 "	31	4.40 "
31	6.50 "	1	4.45 "

TABLE No. 2. Standard Moonlight System.

Date.	Light.	Date.	Exting.
1	6.20 P.M.	2	5.20 A.M.
2	6.20 "	3	5.35 "
3	6.20 "	4	5.35 "
4	6.25 "	5	5.30 "
5	6.25 "	6	5.30 "
6	6.25 "	7	5.30 "
7	6.25 "	8	5.25 "
8	6.25 "	9	5.25 "
9	6.30 "	10	5.25 "
10	9.15 "	11	5.20 "
11	10.10 "	12	5.20 "
12	11.05 "	13	5.15 "
13	—	—	—
14	12.05 A.M.	14	5.15 "
15	1.00 A.M.	15	5.15 "
16	1.50 "	16	5.15 "
17	2.40 "	17	5.10 "
18	3.20 "	18	5.10 "
19	No light.	19	No light.
20	No light.	20	No light.
21	6.40 P.M.	21	8.00 P.M.
22	6.40 "	22	9.15 "
23	6.45 "	23	10.25 "
24	6.45 "	24	11.35 "
25	6.45 "	26	12.40 A.M.
26	6.45 "	27	1.40 "
27	6.50 "	28	2.35 "
28	6.50 "	29	3.20 "
29	6.50 "	30	4.00 "
30	6.50 "	31	4.40 "
31	6.50 "	1	4.45 "

APRIL, 1905

TABLE No. 1. Frund's Moonlight System.

Date.	Light.	Date.	Exting.
1	6.50 P.M.	2	4.45 A.M.
2	6.55 "	3	4.45 "
3	6.55 "	4	4.45 "
4	6.55 "	5	4.40 "
5	6.55 "	6	4.40 "
6	6.55 "	7	4.40 "
7	7.00 "	8	4.35 "
8	7.00 "	9	4.35 "
9	7.00 "	10	4.35 "
10	7.00 "	11	4.30 "
11	7.00 "	12	4.30 "
12	7.05 "	12	12.00 M.
13	12.30 A.M.	13	4.30 A.M.
13	7.05 P.M.	13	12.00 M.
14	1.15 A.M.	14	4.25 A.M.
14	7.05 P.M.	14	12.00 M.
15	2.00 A.M.	15	4.25 A.M.
15	7.05 P.M.	15	12.00 M.
16	7.05 "	16	12.00 "
17	7.10 "	17	12.00 "
18	7.10 "	18	12.00 "
19	7.10 "	19	12.00 "
20	7.10 "	20	12.00 "
21	7.10 "	21	12.00 "
22	7.15 "	22	12.00 "
23	7.15 "	24	12.25 A.M.
24	7.15 "	25	1.15 "
25	7.15 "	26	2.00 "
26	7.15 "	27	2.40 "
27	7.20 "	28	3.15 "
28	7.20 "	29	3.50 "
29	7.20 "	30	4.00 "
30	7.20 "	1	4.00 "

TABLE No. 2. Standard Moonlight System.

Date.	Light.	Date.	Exting.
1	6.50 P.M.	2	4.45 A.M.
2	6.55 "	3	4.45 "
3	6.55 "	4	4.45 "
4	6.55 "	5	4.40 "
5	6.55 "	6	4.40 "
6	6.55 "	7	4.40 "
7	7.00 "	8	4.35 "
8	7.00 "	9	4.35 "
9	10.00 "	10	4.35 "
10	11.00 "	11	4.30 "
11	11.40 "	12	4.30 "
12	—	—	—
13	12.30 A.M.	13	4.30 A.M.
14	1.15 "	14	4.25 "
15	2.00 "	15	4.25 "
16	2.40 "	16	4.25 "
17	No light.	17	No light.
18	No light.	18	No light.
19	No light.	19	No light.
20	7.10 P.M.	20	9.15 P.M.
21	7.10 "	21	10.20 "
22	7.15 "	22	11.25 "
23	7.15 "	24	12.25 A.M.
24	7.15 "	25	1.15 "
25	7.15 "	26	2.00 "
26	7.15 "	27	2.40 "
27	7.20 "	28	3.15 "
28	7.20 "	29	3.50 "
29	7.20 "	30	4.00 "
30	7.20 "	1	4.00 "

MAY, 1905

TABLE No. 1. Frund's Moonlight System.

Date.	Light.	Date.	Exting.
1	7.20 P.M.	2	4.00 A.M.
2	7.20 "	3	4.00 "
3	7.25 "	4	4.00 "
4	7.25 "	5	4.00 "
5	7.25 "	6	4.00 "
6	7.25 "	7	3.55 "
7	7.25 "	8	3.55 "
8	7.30 "	9	3.55 "
9	7.30 "	10	3.55 "
10	7.30 "	11	3.50 "
11	7.30 "	12	3.50 "
12	7.30 "	13	3.50 "
13	7.35 "	13	12.00 M.
14	1.15 A.M.	14	3.50 A.M.
14	7.35 P.M.	14	12.00 M.
15	7.35 "	15	12.00 "
16	7.35 "	16	12.00 "
17	7.35 "	17	12.00 "
18	7.40 "	18	12.00 "
19	7.40 "	19	12.00 "
20	7.40 "	20	12.00 "
21	7.40 "	21	12.00 "
22	7.40 "	22	12.00 "
23	7.45 "	24	12.40 A.M.
24	7.45 "	25	1.15 "
25	7.45 "	26	1.50 "
26	7.45 "	27	2.20 "
27	7.45 "	28	2.50 "
28	7.45 "	29	3.20 "
29	7.45 "	30	3.35 "
30	7.50 "	31	3.35 "
31	7.50 "	1	3.35

TABLE No. 2. Standard Moonlight System.

Date.	Light.	Date.	Exting.
1	7.20 P.M.	2	4.00 A.M.
2	7.20 "	3	4.00 "
3	7.25 "	4	4.00 "
4	7.25 "	5	4.00 "
5	7.25 "	6	4.00 "
6	7.25 "	7	3.55 "
7	7.25 "	8	3.55 "
8	9.40 "	9	3.55 "
9	10.30 "	10	3.55 "
10	11.15 "	11	3.50 "
11	11.55 "	12	3.50 "
12	—	—	—
13	12.35 A.M.	13	3.50 A.M.
14	1.15 "	14	3.50 "
15	1.50 "	15	3.50 "
16	No light.	16	No light.
17	No light.	17	No light.
18	No light.	18	No light.
19	7.40 P.M.	19	9.10 P.M.
20	7.40 "	20	10.10 "
21	7.40 "	21	11.10 "
22	7.40 "	22	11.55 "
23	7.45 "	24	12.40 A.M.
24	7.45 "	25	1.15 "
25	7.45 "	26	1.50 "
26	7.45 "	27	2.20 "
27	7.45 "	28	2.50 "
28	7.45 "	29	3.20 "
29	7.45 "	30	3.35 "
30	7.50 "	31	3.35 "
31	7.50 "	1	3.35 "

JUNE, 1905

TABLE No. 1. Frund's Moonlight System.

Date.	Light.	Date.	Exting.
1	7.50 P.M.	2	3.35 A.M.
2	7.50 "	3	3.35 "
3	7.50 "	4	3.35 "
4	7.50 "	5	3.35 "
5	7.50 "	6	3.35 "
6	7.50 "	7	3.35 "
7	7.55 "	8	3.35 "
8	7.55 "	9	3.30 "
9	7.55 "	10	3.30 "
10	7.55 "	11	3.30 "
11	7.55 "	12	3.30 "
12	7.55 "	13	3.30 "
13	7.55 "	13	12.00 M.
14	7.55 "	14	12.00 "
15	7.55 "	15	12.00 "
16	7.55 "	16	12.00 "
17	8.00 "	17	12.00 "
18	8.00 "	18	12.00 "
19	8.00 "	19	12.00 "
20	8.00 "	20	12.00 "
21	8.00 "	21	12.00 "
22	8.00 "	23	12.20 A.M.
23	8.00 "	24	12.50 "
24	8.00 "	25	1.20 "
25	8.00 "	26	1.50 "
26	8.00 "	27	2.20 "
27	8.00 "	28	2.50 "
28	8.00 "	29	3.30 "
29	8.00 "	30	3.30 "
30	8.00 "	1	3.30 "

TABLE No. 2. Standard Moonlight System.

Date.	Light.	Date.	Exting.
1	7.50 P.M.	2	3.35 A.M.
2	7.50 "	3	3.35 "
3	7.50 "	4	3.35 "
4	7.50 "	5	3.35 "
5	7.50 "	6	3.35 "
6	7.50 "	7	3.35 "
7	7.55 "	8	3.35 "
8	10.40 "	9	3.30 "
9	11.15 "	10	3.30 "
10	11.50 "	11	3.30 "
11	—	—	—
12	12.25 A.M.	12	3.30 A.M.
13	1.00 "	13	3.30 "
14	1.40 "	14	3.30 "
15	No light.	15	No light.
16	No light.	16	No light.
17	No light.	17	No light.
18	8.00 P.M.	18	9.50 P.M.
19	8.00 "	19	10.30 "
20	8.00 "	20	11.15 "
21	8.00 "	21	11.50 "
22	8.00 "	23	12.20 A.M.
23	8.00 "	24	12.50 "
24	8.00 "	25	1.20 "
25	8.00 "	26	1.50 "
26	8.00 "	27	2.20 "
27	8.00 "	28	2.50 "
28	8.00 "	29	3.30 "
29	8.00 "	30	3.30 "
30	8.00 "	1	3.30 "

JULY, 1905

TABLE No. 1. Frund's Moonlight System.

Date.	Light.	Date.	Exting.
1	8.00 M.	2	3.35 A.M.
2	8.00 "	3	3.35 "
3	8.00 "	4	3.35 "
4	8.00 "	5	3.35 "
5	8.00 "	6	3.35 "
6	8.00 "	7	3.35 "
7	8.00 "	8	3.35 "
8	8.00 "	9	3.35 "
9	8.00 "	10	3.35 "
10	8.00 "	11	3.40 "
11	8.00 "	12	3.40 "
12	8.00 "	13	3.40 "
13	8.00 "	13	12.00 M.
14	8.00 "	14	12.00 "
15	8.00 "	15	12.00 "
16	8.00 "	16	12.00 "
17	8.00 "	17	12.00 "
18	8.00 "	18	12.00 "
19	8.00 "	19	12.00 "
20	7.55 "	20	12.00 "
21	7.55 "	21	12.00 "
22	7.55 "	22	12.00 "
23	7.55 "	24	12.20 A.M.
24	7.55 "	25	12.50 "
25	7.55 "	26	1.20 "
26	7.50 "	27	2.00 "
27	7.50 "	28	2.40 "
28	7.50 "	29	3.25 "
29	7.50 "	30	3.55 "
30	7.50 "	31	3.55 "
31	7.45 "	1	3.55 "

TABLE No. 2. Standard Moonlight System.

Date.	Light.	Date.	Exting.
1	8.00 P.M.	2	3.35 A.M.
2	8.00 "	3	3.35 "
3	8.00 "	4	3.35 "
4	8.00 "	5	3.35 "
5	8.00 "	6	3.35 "
6	8.00 "	7	3.35 "
7	9.50 "	8	3.35 "
8	10.30 "	9	3.35 "
9	11.05 "	10	3.35 "
10	11.40 "	11	3.40 "
11	—	—	—
12	12.20 A.M.	12	3.40 "
13	1.05 "	13	3.40 "
14	1.55 "	14	3.40 "
15	No light.	15	No light.
16	No light.	16	No light.
17	No light.	17	No light.
18	8.00 P.M.	18	9.45 P.M.
19	8.00 "	19	10.20 "
20	7.55 "	20	10.50 "
21	7.55 "	21	11.20 "
22	7.55 "	22	11.50 "
23	7.55 "	24	12.20 A.M.
24	7.55 "	25	12.50 "
25	7.55 "	26	1.20 "
26	7.50 "	27	2.00 "
27	7.50 "	28	2.40 "
28	7.50 "	29	3.25 "
29	7.50 "	30	3.55 "
30	7.50 "	31	3.55 "
31	7.45 "	1	3.55 "

AUGUST, 1905

TABLE No. 1. Frund's Moonlight System.

Date.	Light.	Date.	Exting.
1	7.45 P.M.	2	3.55 A.M.
2	7.45 "	3	3.55 "
3	7.45 "	4	3.55 "
4	7.45 "	5	4.00 "
5	7.40 "	6	4.00 "
6	7.40 "	7	4.00 "
7	7.40 "	8	4.00 "
8	7.40 "	9	4.00 "
9	7.40 "	10	4.05 "
10	7.35 "	11	4.05 "
11	7.35 "	11	12.00 M.
12	7.35 "	12	12.00 "
13	7.30 "	13	12.00 "
14	7.30 "	14	12.00 "
15	7.30 "	15	12.00 "
16	7.30 "	16	12.00 "
17	7.25 "	17	12.00 "
18	7.25 "	18	12.00 "
19	7.25 "	19	12.00 "
20	7.20 "	20	12.00 "
21	7.20 "	21	12.00 "
22	7.20 "	22	12.00 "
23	7.20 "	24	12.30 A.M.
24	7.15 "	25	1.15 "
25	7.15 "	26	2.05 "
26	7.15 "	27	3.05 "
27	7.15 "	28	4.05 "
28	7.10 "	29	4.20 "
29	7.10 "	30	4.25 "
30	7.10 "	31	4.25 "
31	7.05 "	1	4.25 "

TABLE No. 2. Standard Moonlight System.

Date.	Light.	Date.	Exting.
1	7.45 P.M.	2	3.55 A.M.
2	7.45 "	3	3.55 "
3	7.45 "	4	3.55 "
4	7.45 "	5	4.00 "
5	9.10 "	6	4.00 "
6	9.45 "	7	4.00 "
7	10.20 "	8	4.00 "
8	11.05 "	9	4.00 "
9	11.50 "	10	4.05 "
10	—	—	—
11	12.40 A.M.	11	4.05 "
12	1.35 "	12	4.05 "
13	2.35 "	13	4.05 "
14	No light.	14	No light.
15	No light.	15	No light.
16	7.25 P.M.	16	8.50 P.M.
17	7.25 "	17	9.25 "
18	7.25 "	18	9.50 "
19	7.25 "	19	10.20 "
20	7.20 "	20	10.50 "
21	7.20 "	21	11.20 "
22	7.20 "	22	11.55 "
23	7.20 "	24	12.30 A.M.
24	7.15 "	25	1.15 "
25	7.15 "	26	2.05 "
26	7.15 "	27	3.05 "
27	7.15 "	28	4.05 "
28	7.10 "	29	4.20 "
29	7.10 "	30	4.25 "
30	7.10 "	31	4.25 "
31	7.05 "	1	4.25 "

SEPTEMBER, 1905

TABLE No. 1. Frund's Moonlight System.

Date.	Light.	Date.	Exting.
1	7.05 P.M.	2	4.25 A.M.
2	7.05 "	3	4.25 "
3	7.00 "	4	4.25 "
4	7.00 "	5	4.30 "
5	7.00 "	6	4.30 "
6	6.55 "	7	4.30 "
7	6.55 "	8	4.30 "
8	6.55 "	9	4.30 "
9	6.50 "	10	4.35 "
10	6.50 "	10	12.00 M.
11	6.50 "	11	12.00 "
12	6.50 "	12	12.00 "
13	6.45 "	13	12.00 "
14	6.45 "	14	12.00 "
15	6.45 "	15	12.00 "
16	6.40 "	16	12.00 "
17	6.40 "	17	12.00 "
18	6.40 "	18	12.00 "
19	6.35 "	19	12.00 "
20	6.35 "	20	12.00 "
21	6.35 "	21	12.00 "
22	6.35 "	23	12.20 A.M.
23	6.30 "	24	1.45 "
24	6.25 "	25	2.50 "
25	6.25 "	26	3.55 "
26	6.25 "	27	4.50 "
27	6.20 "	28	4.50 "
28	6.20 "	29	4.50 "
29	6.20 "	30	4.50 "
30	6.15 "	1	4.55 A.M.

TABLE No. 2. Standard Moonlight System.

Date.	Light.	Date.	Exting.
1	7.05 P.M.	2	4.25 A.M.
2	7.05 "	3	4.25 "
3	7.05 "	4	4.25 "
4	9.00 "	5	4.30 "
5	9.50 "	6	4.30 "
6	10.40 "	7	4.30 "
7	11.30 "	8	4.30 "
8	—	—	—
9	12.25 A.M.	9	4.35 "
10	1.25 "	10	4.35 "
11	2.25 "	11	4.35 "
12	No light.	12	No light.
13	No light.	13	No light.
14	6.45 P.M.	14	8.00 P.M.
15	6.45 "	15	8.20 "
16	6.40 "	16	8.50 "
17	6.40 "	17	9.20 "
18	6.40 "	18	9.50 "
19	6.35 "	19	10.30 "
20	6.35 "	20	11.10 "
21	6.35 "	21	11.55 "
22	6.30 "	23	12.50 A.M.
23	6.30 "	24	1.45 "
24	6.25 "	25	2.50 "
25	6.25 "	26	3.55 "
26	6.25 "	27	4.50 "
27	6.20 "	28	4.50 "
28	6.20 "	29	4.50 "
29	6.20 "	30	4.50 "
30	6.15 "	1	4.55 "

OCTOBER, 1905

TABLE No. 1. Frund's Moonlight System.

Date.	Light.	Date.	Exting.

TABLE No. 2. Standard Moonlight System.

Date.	Light.	Date.	Exting.

NOVEMBER, 1905

TABLE No. 1. Frund's Moonlight System.

Date.	Light.	Date.	Exting.

TABLE No. 2. Standard Moonlight System.

Date.	Light.	Date.	Exting.

DECEMBER, 1905

TABLE No. 1. Frund's Moonlight System.

Date.	Light.	Date.	Exting.

TABLE No. 2. Standard Moonlight System.

Date.	Light.	Date.	Exting.

OCTOBER, 1905

Table No. 1.
Frund's Moonlight System.

Date.	Light.	Date.	Exting.
1	6.15 P.M.	2	4.55 A.M.
2	6.15 "	3	4.55 "
3	6.15 "	4	4.55 "
4	6.10 "	5	4.55 "
5	6.10 "	6	5.00 "
6	6.10 "	7	5.00 "
7	6.05 "	8	5.00 "
8	6.05 "	8	12.00 M.
9	1.20 A.M.	9	5.00 A.M.
9	6.05 P.M.	9	12.00 M.
10	6.00 "	10	12.00 "
11	6.00 "	11	12.00 "
12	6.00 "	12	12.00 "
13	5.55 "	13	12.00 "
14	5.55 "	14	12.00 "
15	5.55 "	15	12.00 "
16	5.50 "	16	12.00 "
17	5.50 "	17	12.00 "
18	5.50 "	18	12.00 "
19	5.45 "	19	12.00 "
20	5.45 "	20	12.00 "
21	5.45 "	22	12.30 A.M.
22	5.45 "	23	1.35 "
23	5.40 "	24	2.40 "
24	5.40 "	25	3.50 "
25	5.40 "	26	5.00 "
26	5.35 "	27	5.20 "
27	5.35 "	28	5.20 "
28	5.35 "	29	5.20 "
29	5.35 "	30	5.25 "
30	5.35 "	31	5.25 "
31	5.30 "	1	5.25 "

Table No. 2.
Standard Moonlight System.

Date.	Light.	Date.	Exting.
1	6.15 P.M.	2	4.55 A.M.
2	7.40 "	3	4.55 "
3	8.30 "	4	4.55 "
4	9.25 "	5	4.55 "
5	10.20 "	6	5.00 "
6	11.20 "	7	5.00 "
7	———	———	———
8	12.20 A.M.	8	5.00 "
9	1.20 "	9	5.00 "
10	2.15 "	10	5.00 "
11	3.10 "	11	5.05 "
12	No light.	12	No light.
13	No light.	13	No light.
14	No light.	14	No light.
15	5.55 P.M.	15	7.55 P.M.
16	5.50 "	16	8.30 "
17	5.50 "	17	9.10 "
18	5.50 "	18	9.50 "
19	5.45 "	19	10.40 "
20	5.45 "	20	11.30 "
21	5.45 "	22	12.30 "
22	5.45 "	23	1.35 "
23	5.40 "	24	2.40 "
24	5.40 "	25	3.50 "
25	5.40 "	26	5.00 "
26	5.35 "	27	5.20 "
27	5.35 "	28	5.20 "
28	5.35 "	29	5.20 "
29	5.35 "	30	5.25 "
30	5.35 "	31	5.25 "
31	5.30 "	1	5.25 "

NOVEMBER, 1905

Table No. 1.
Frund's Moonlight System.

Date.	Light.	Date.	Exting.
1	5.30 P.M.	2	5.25 A.M.
2	5.30 "	3	5.30 "
3	5.30 "	4	5.30 "
4	5.25 "	5	5.30 "
5	5.25 "	6	5.30 "
6	5.25 "	6	12.00 M.
7	1.05 A.M.	7	5.35 A.M.
7	5.25 P.M.	7	12.00 M.
8	2.05 A.M.	8	5.35 A.M.
8	5.25 P.M.	8	12.00 M.
9	5.20 "	9	12.00 "
10	5.20 "	10	12.00 "
11	5.20 "	11	12.00 "
12	5.20 "	12	12.00 "
13	5.20 "	13	12.00 "
14	5.15 P.M.	14	12.00 "
15	5.15 "	15	12.00 "
16	5.15 "	16	12.00 "
17	5.15 "	17	12.00 "
18	5.15 "	18	12.00 "
19	5.15 "	20	12.25 A.M.
20	5.15 "	21	1.30 "
21	5.10 "	22	2.40 "
22	5.10 "	23	3.50 "
23	5.10 "	24	5.05 "
24	5.10 "	25	5.55 "
25	5.10 "	26	5.55 "
26	5.10 "	27	5.55 "
27	5.10 "	28	5.55 "
28	5.10 "	29	6.00 "
29	5.10 "	30	6.00 "
30	5.05 "	1	6.00 "

Table No. 2.
Standard Moonlight System.

Date.	Light.	Date.	Exting.
1	5.30 P.M.	2	5.25 A.M.
2	9.10 "	3	5.30 "
3	10.10 "	4	5.30 "
4	11.10 "	5	5.30 "
5	———	———	———
6	12.10 A.M.	6	5.30 "
7	1.05 "	7	5.35 "
8	2.05 "	8	5.35 "
9	3.00 "	9	5.35 "
10	4.00 "	10	5.40 "
11	No light.	11	No light.
12	No light.	12	No light.
13	No light.	13	No light.
14	5.15 P.M.	14	7.50 P.M.
15	5.15 "	15	8.35 "
16	5.15 "	16	9.25 "
17	5.15 "	17	10.25 "
18	5.15 "	18	11.25 "
19	5.15 "	20	12.25 A.M.
20	5.15 "	21	1.30 "
21	5.10 "	22	2.40 "
22	5.10 "	23	3.50 "
23	5.10 "	24	5.05 "
24	5.10 "	25	5.55 "
25	5.10 "	26	5.55 "
26	5.10 "	27	5.55 "
27	5.10 "	28	5.55 "
28	5.10 "	29	6.00 "
29	5.10 "	30	6.00 "
30	5.05 "	1	6.00 "

DECEMBER, 1905

Table No. 1.
Frund's Moonlight System.

Date.	Light.	Date.	Exting.
1	5.05 P.M.	2	6.00 A.M.
2	5.05 "	3	6.00 "
3	5.05 "	4	6.05 "
4	5.05 "	5	6.05 "
5	5.05 "	5	12.00 M.
6	12.50 A.M.	6	6.05 A.M.
6	5.05 P.M.	6	12.00 M.
7	1.50 A.M.	7	6.05 A.M.
7	5.05 P.M.	7	12.00 M.
8	5.05 "	8	12.00 "
9	5.05 "	9	12.00 "
10	5.05 "	10	12.00 "
11	5.05 "	11	12.00 "
12	5.05 "	12	12.00 "
13	5.05 "	13	12.00 "
14	5.05 "	14	12.00 "
15	5.05 "	15	12.00 "
16	5.05 "	16	12.00 "
17	5.05 "	17	12.00 "
18	5.05 "	19	12.30 A.M.
19	5.05 "	20	1.40 "
20	5.05 "	21	2.50 "
21	5.05 "	22	3.50 "
22	5.05 "	23	5.10 "
23	5.05 "	24	6.20 "
24	5.05 "	25	6.20 "
25	5.10 "	26	6.20 "
26	5.10 "	27	6.20 "
27	5.10 "	28	6.20 "
28	5.10 "	29	6.20 "
29	5.10 "	30	6.20 "
30	5.10 "	31	6.20 "
31	5.10 "	1	6.20 "

Table No. 2.
Standard Moonlight System.

Date.	Light.	Date.	Exting.
1	9.00 P.M.	2	6.00 A.M.
2	10.00 "	3	6.00 "
3	11.00 "	4	6.05 "
4	11.55 "	5	6.05 "
5	———	———	———
6	12.50 A.M.	6	6.05 A.M.
7	1.50 "	7	6.05 "
8	2.45 "	8	6.10 "
9	3.40 "	9	6.10 "
10	4.35 "	10	6.10 "
11	No light.	11	No light.
12	No light.	12	No light.
13	5.05 P.M.	13	7.20 P.M.
14	5.05 "	14	8.20 "
15	5.05 "	15	9.20 "
16	5.05 "	16	10.20 "
17	5.05 "	17	11.25 "
18	5.05 "	19	12.30 A.M.
19	5.05 "	20	1.40 "
20	5.05 "	21	2.50 "
21	5.05 "	22	3.50 "
22	5.05 "	23	5.10 "
23	5.05 "	24	6.20 "
24	5.05 "	25	6.20 "
25	5.10 "	26	6.20 "
26	5.10 "	27	6.20 "
27	5.10 "	28	6.20 "
28	5.10 "	29	6.20 "
29	5.10 "	30	6.20 "
30	5.10 "	31	6.20 "
31	8.40 "	1	6.20 "

A New System of Train Control.

An interesting system for controlling motor-driven cars on the multiple-unit plan is the subject of a patent recently issued to the Cutler-Hammer Manufacturing Company. The novel feature of the system is that both the direction and the speed of all the train car motors are controlled by means of two small conductors in connection with a controller of about the size of a field regulator used with a 3-kw generator. It is even possible to reduce the train control wire to a single conductor by utilizing a rail return, though this would probably be objectionable.

The two wires constituting the train line are attached at each end of the car to automatic couplings, which require no attention in coupling up so far as the electrical equipment is concerned. The maximum current carried by the two-wire train line is the output of a 3-kw, 110-volt generator when used in connection with six cars equipped with four motors on each car, capable of developing 300 hp per car, or 1,800 hp per train of six cars. Each car may be equipped with a 3-kw motor-generator, *Mg*, capable of controlling the speed of the motors of the entire train, or by another method each car can be equipped with a ½-kw motor-generator, capable of controlling the speed of its own car only. The direction of travel of the train is controlled in accordance with the direction of the current flowing in the two-wire train line, while the speed of the train is controlled by the voltage impressed upon

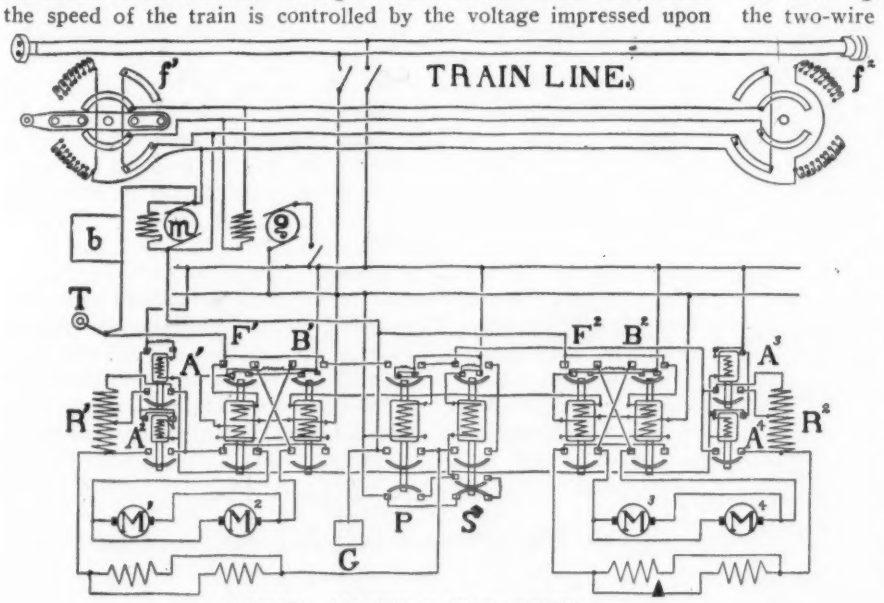


DIAGRAM OF TRAIN CONTROL SYSTEM.

the two-wire train line. These wires are utilized for supplying the necessary current for energizing the windings of a number of solenoid switches, which control the current supplied to the car-driving motors, M^1, M^2, M^3, M^4.

The accompanying drawing shows the two driving motors on each truck treated practically as one motor, but provided with an independent solenoid reversing switch, *F B* and two solenoid accelerating switches, *A*, for cutting out the starting resistance, *R*. Two other solenoid switches, *S P*, are also employed for connecting the motors on one truck, either in series relation with the motors on the other truck or in parallel relation therewith in accordance with the speed desired.

The method of operating the reversing switches in accordance with the direction of the current flowing through the two-wire train line is quite simple. Each solenoid used on the reversing switches, *F B*, is provided with two windings. One of these windings is permanently connected between the trolley, *T*, or third rail and the ground, *G*. The other winding is permanently connected to the train line. The forward solenoid reversing switch, *F*, is wound left-handed and the back-up solenoid reversing switch, *B*, is wound right-handed. It is evident, therefore, that when the current is flowing in the train line in one direction, it will assist the winding of one of the solenoid switches and neutralize the action of the other solenoid winding, so that the desired solenoid switch will be energized in accordance with the direction of the current flowing in the two-wire train line. The accelerating solenoids and the series and paralleling solenoids are wound to actuate their plungers at different voltages. The operation of the system is briefly as follows:

Each car being equipped with a 3-kw motor-generator, *M g*, at each end is installed a 3-kw field regulator, *F*, having a double set of resistance buttons and segments. An ordinary 3-kw, 110-volt starting box, *b*, is also provided. The operator first starts the 3-kw motor by means of this starting box. He then moves the field regulator lever, *F'*, in the direction in which it is desired to move the train. When the lever of the field regulator makes contact with the first step of the resistance, current is admitted through this resistance to the shunt field of the 3-kw generator, *g*, thereby causing it to impress a voltage on the two-wire train line of, say, 20 volts. This voltage is sufficient to supply enough current to energize the forward reversing solenoids, F^1 F^2, and cause them to lift their plungers, assisted by the current taken directly from the trolley or third rail. The same voltage also supplies sufficient current to energize the winding of the series solenoid switch, *S*, which attracts its plunger and closes the circuit of the four driving motors, M^1, M^2, M^3, M^4, in series relation. The operator then moves his 3-kw field regulator lever to the second notch, which increases the voltage on the two-wire train line to, say, 40 volts, which is sufficient to energize the first of the solenoid switches, A^1, A^2, for cutting out the first step of starting resistances, R^1, R^2. The operator then continues to advance the field regulator lever, thus gradually increasing the voltage on the two-wire train line until finally the second step of resistances, R^1, R^2, is cut out. The paralleling switch, *P*, is then energized and the starting resistances, R^1, R^2, reinserted, which resistances are then again cut out until the driving motors are finally operating in parallel relation at full speed. The only wires which run the entire length of the car are the two train wires, capable of carrying about 30 amp., and the four-wire cable connecting the two 3-kw field regulators, and capable of carrying a small fraction of an ampere in each wire. The solenoid switches controlling the driving motors are assembled in two sets near each truck, so that only four large wires are necessary for connecting the motors on the two trucks in series or parallel relation.

According to a second method, a ½-kw motor-generator is installed on each car and varies the voltage of each generator by varying the voltage of the train line. In this case the train line carries current sufficient only for energizing the fields of the generators at 500 volts, or about 6/10 of an ampere, the field winding being adapted for 500 volts and the armature windings having a maximum of 110 volts for supplying the various solenoid windings on each car.

It will be noted that there is no operator's switch in the train line circuit, and that the system is totally different from the usual method employing a multiplicity of wires running the entire length of the train, and utilizing each wire to energize some particular set of solenoids. The system, moreover, employs only a low voltage on the solenoid windings, as well as on the controlling wires. It is practically impossible for the operator to accelerate the train too rapidly, for the reason that the potential of the generators used will not respond instantly to changes in the energizing current of their field magnets when designed with this feature in mind. In practice, therefore, the operator has merely to move his controlling lever to the full-speed position and the train will smoothly and rapidly acquire full speed without further attention.

Wireless Telegraphic Communications.

Wireless telegraphic communications have just been established between Chicago and Kansas City, a distance of about 450 miles. One of the first messages sent was that by Dr. Lee De Forest to John Farsons, stating that the De Forest Wireless Telegraph Company would begin commercial business from Kansas City to St. Louis and Springfield in a few days. It is announced that in about two weeks the system will be ready for business out of Chicago.

"Frenzied" Municipal Finance in England.

A great deal of attention is being devoted in England at the present time to the serious and enormous growth of municipal indebtedness, and some of the leading financial and economic authorities in the country are giving strong utterance to words of warning and caution. The rate at which municipal indebtedness has grown is shown by the fact that while the proportion of local to national debt in 1874-5 was only 12.6 per cent., it had risen in 1901-2 to not less than 44.69 per cent. The local debts of municipal and kindred authorities have nearly quadrupled in 30 years and threaten at an early date to equal the national debt of Great Britain, which now represents a sum around $4,000,000,000. In a recent article on the subject the London *Express* quotes an eminent financial authority in that city as follows:

"At the present moment," he said, "it is the ambition of every borough council and of many a rural council to have its own electric light and electric tramway, apart from the question of making the undertaking profitable. What one body does another body aspires to better. One builds a palatial set of public baths, and its neighbor at once sets about erecting baths which shall be not less imposing, and, if possible, more so. The result has been that public baths, although a very desirable thing, are a financial failure. Local authorities have borrowed £2,000,000 for baths and wash houses," he continued, "and the net result is an annual loss of £125,000 a year. In many instances, the wash houses are largely used by washerwomen, who thus secure business premises at the rate payers' cost.

"But the most striking development of late years," he added, "has, of course, been in tramways. Nearly 140 public bodies now own tramways against 120 companies. They have spent £21,000,000 on their works, as against £14,000,000 spent on a nearly equal number of non-municipal undertakings. Since 1891 no less than £25,000,000 has been borrowed for tramway purposes. In many instances, the municipal body has paid a large sum to secure immediate possession of a company's lines, and has then ripped the lines up, sold the cars for an old song and made a lavish outlay on electrification, following implicitly the advice of an expert whose remuneration is in proportion to the amount of money he can persuade the authority to spend. The London County Council has incurred a dead loss of £1,000,000 for old tramlines and prehistoric cars, which it bought only to throw aside.

"Look again at electric lighting. Electric lighting has swallowed up £30,000,000 within the last few years, and half the undertakings in the country are in the hands of local bodies made up of councillors who know nothing about electricity, and who, except in the case of some of the leading city councils, are mostly small tradesmen utterly inexperienced in the management of a large business undertaking of a very difficult kind. What is the result? Why, already over fifty public bodies have handed over their rights of lighting to companies. Twenty-three others have bought lighting rights from companies. The notorious case of Marylebone, which lately found itself saddled with a bill for £1,212,000 for its electric lighting undertaking, is a concrete instance of reckless municipalization."

In connection with this subject, it was also pointed out that many of the local authorities have become so pinched and driven by their extravagances that they have taken to the practice of securing large overdrafts from their bankers. It is also believed that, as in America, many of the municipalities are virtually a year ahead as to spending their taxation, so that the year's taxes would virtually be equivalent to the same amount of floating debt. The local indebtedness in England is now equal to $50 per head of the population.

Concentration of Power Plants at Navy Yards.

The subject of improving the power plants in United States Navy Yards has been reported on by Stone & Webster, of Boston. The various kinds of power and miscellaneous service capable of concentration for which provision is now made at the various yards may be classified as follows: (1) Production of electricity for power and light; (2) pneumatic power; (3) hydraulic power; (4) live steam; (5) heating of buildings by steam or hot water, and (6) fire protection. At the larger yards the firm found three, and in some cases four, separate and distinct power plants ranging in size from 100 to about 2,000 hp. Furthermore, the existing plants at a number of yards have been so designed and installed, by intent or otherwise, as practically to prevent interchange of electric power between departments, one department using alternating current and another direct, or one using alternating current of a certain character and another alternating current of a different character. As a ship under repair will generally have work for every department represented on it, a breakdown of any one of the present numerous power plants would delay the completion of the work as much as any probable accident to a properly designed central power plant. The conclusions and recommendations of the engineers are in part as follows:

A study of the conditions under which the present power supply is produced warrants the conclusion that the yearly cost of power in a central plant should be less than the present costs by the following amounts:

Portsmouth	$20,000
Boston	25,000
New York	30,000
League Island	18,000
Norfolk	15,000
Total	$108,000

The estimated expenditure required to effect these reductions should not exceed:

Portsmouth	$250,000
Boston	250,000
New York	450,000
League Island (net)	75,000
Norfolk	250,000
Total	$1,275,000

The following recommendations are made: That the operation of the consolidated plant be placed on a central station basis; that is, it should be ready at all times, day and night, to furnish an ample supply of power to any department; and should be placed in charge of men experienced in commercial central station operation, as undoubtedly a large part of the opposition that has developed to a consolidated plant is the apprehension of the different departments that they will be handicapped in their work by an inefficient or insufficient power supply, and that it will be impossible to get emergency overtime power. This feeling, which is due to the present method of handling interdepartment business, with its attendant delays, will make it necessary to so change the department regulations as to make it possible for any department head to call directly upon the power-producing department for such power and at such times as he may need it.

The Production of Steel-Hardening Metals.

In the annual volume of the United States Geological Survey entitled "Mineral Resources of the United States, 1903," is a report by Dr. Joseph Hyde Pratt on the production of steel-hardening metals. Under this head are included nickel and cobalt, chromium, tungsten, molybdenum, vanadium, titanium and uranium, which are named in the order of the importance of their production and use for steel-hardening purposes. In this list manganese would naturally be included, but on account of its very extensive production and its large use in the purification of steel it is treated in a separate report. A peculiarity of the metals about which Doctor Pratt writes is the fact that they are not added to the steel in the process of manufacture to cause chemical reactions that drive off harmful ingredients, as are ferro-silicon and ferro-manganese. They are added only after the steel has been manufactured, and the benefits conferred on the steel by their use are of a physical nature.

The special steels resulting from these additions vary among themselves, having individual properties of tensile strength and elastic limit, of conductivity, heat and electricity, of magnetic capacity, and of resistance to impact, whether as shell or as armor plate. It is only about twenty years since the first of these metals, nickel, began to be used to any extent for hardening steel. Experiments to determine the qualities that some of them impart to steel, and their consequent commercial value, are now conducted on a large scale by means of the electric furnace, which makes possible the reduction of the ferro alloys directly from the ores. Doctor Pratt devotes considerable space to descriptions of the peculiar properties possessed by the various ferro alloys and the manifold uses to which manganese steel, nickel steel, cobalt steel, chromium steel, tungsten steel, molybdenum steel and vanadium steel are applied.

CURRENT NEWS AND NOTES.

ELECTRICAL CONTRACTORS.—The annual meeting of the Electrical Contractors' Association, of New York State, will be held on Tuesday, January 17, at Troy, N. Y. Mr. F. Fish, of Rochester, N. Y., is the secretary.

LOGIC AND LIGHT.—Prof. Charles H. Rieber, of the University of California, is perfecting a logic machine that will answer syllogistic propositions as fast as proposed. His machine is said to be an improvement on that of Stanley Jevons, the English logician. It will follow what logicians know as "circle notation," wherein all premises having separate symbols and conclusions are produced by a combination of these symbols. Prof. Rieber has designed a machine something like an adding machine, which by the manipulation of circles and electric lights, will, when the proper keys are pressed down, throw into relief all formulas that are possible answers to logical questions without the chance of an error.

WIRELESS ON THE PACIFIC.—On December 9 the Government tug *Unadilla* left Mare Island Navy Yard with a party of expert electricians and a complete wireless telegraph outfit, which is to be installed on one of the Farallone Islands. The battleship *Ohio* will probably soon go to the Farallones to make tests of the wireless system, which it is purposed to extend to Honolulu. In addition to this, Seattle will be connected with Port Townsend, Fort Casey, French Harbor and Victoria, B. C., by wireless telegraph. A wireless telegraph station has been erected on top of Queen Anne Hill in Seattle, and in a short time messages will be received for transmission. Apparatus has also been installed on the revenue cutter *Grant,* so that communication may be had with the shore station when the cutter is in those waters.

NEW BOSTON TUNNEL.—The announcement is made by officials of the Boston Elevated Railway Company that the East Boston tunnel will be opened to public travel on Christmas Day, Sunday, December 25. Major Ainsley R. Hooper, of Governor Bates's staff received the information from General Bancroft, president of the Elevated, and communicated it to the committee which is making arrangements for a celebration of the event. Having made tentative plans in advance, the committee is ready to announce that the East Boston celebration of the opening will occur on Friday evening, December 23. It will consist of a banquet in Masonic Hall, to which Governor Bates, the Boston Transit Commissioners, the Railroad Commissioners and officials of the Elevated will be invited. Special cars are to go through the tunnel.

THE SUBWAY TRACK BED.—At a meeting of the advisory board of the New York Health Department the doctors assailed the roadbed of the Subway. Dr. A. Jacobs said: "The consensus of opinion of the members of the advisory board is that there must be a new floor in the Subway. It must be changed. The floor or roadway was made wrong. The floor should have been made smooth so that it could have been swept and thus kept clean. The floor is at present made of broken stone, and this was the greatest mistake that was made. It is impossible to keep this clean when cigars and cigarettes are thrown into the roadbed. Men also spit on the roadbed, and this of course is extremely bad for the air. It adds great impurities." The roadbed was well wetted and traffic was held up last week by the bursting of a water main on the Boulevard.

METERS AT MEMPHIS, TENN.—The Memphis Consolidated Gas & Electric Company is returning to consumers of electricity the deposits of $7.50 required to guarantee the return of the meters put into houses. Reduction in the prices of electricity and illuminating gas are to be made July 1, 1905. Consumers of electricity were required to deposit $7.50 to cover the expense of making the connection, and that deposit is still required and will not be returned. Later on the company required the deposit of another $7.50 to guarantee the lamps and meters and the payment of bills. Officials of the company hold that it is upon the same standing as merchants, and if it sees fit to credit consumers it will do so. If a citizen has a deposit with the company a letter is written informing him that by applying at the office the deposit will be refunded. After July 1, 1905, officials of the company announce that the price of electricity will be lowered from 11 cents net per kilowatt-hour to 10 cents.

PERRINE ON TRANSMISSION.—Dr. Frederic A. C. Perrine, delivered an address before the Commercial Club at its dinner at the new Algonquin Club, Boston, on December 15. The speaker's theme was the long-distance transmission of water power through the medium of electricity, and he said that they have not begun to appreciate this element of wealth in New England to the degree that they should. "New England today," he said, "is filled with valuable water powers that are running to waste. In northern Maine there is as much power running to waste as there is in Niagara, and in Vermont there are water powers by the score. It is not only one of the possibilities, but one of the probabilities that New England will regain much that she is said to have lost of manufacturing leadership by reason of the development in the future of these sources of power." President Elihu Thomson presided, and those present included many of the most prominent business men of Boston.

AUTOMOBILE CLUB DINNER.—The annual banquet of the Automobile Club of America will take place as usual at the Waldorf-Astoria on the last evening of the Automobile Show, January 21. Mr. Hedge, chairman of the house committee, who was so successful with the 1904 annual reunion, announces that the sixth annual banquet will not be excelled by any such dinner ever given in New York. The grand ballroom and the Astor Gallery will be splendidly decorated in a very unique manner. Among the speakers will be some very prominent men, including Senator John H. Mitchell, of Portland, Ore., who is chairman of the Committee on Coast Defenses of the United States; the Hon. Charles F. Warwick, of Philadelphia; Winthrop E. Scarritt, former president of the club; Samuel Walter Taylor, William Phelps Eno, William H. Page, Jr., and others. President Dave H. Morris will preside. The menu is decidedly original. The dinner will begin promptly at eight o'clock.

SUBMARINE CABLE TO ISTHMUS.—At Washington, on December 8, a bill providing for the connection of the canal zone on the Isthmus of Panama with the United States by cable was introduced by Representative Wagner, of Pennsylvania. The bill provides for the construction and operation of such a cable under the control and direction of the Postmaster-General, the Secretary of War and the Secretary of the Navy, the cable to be of American make and to be laid by American ships, provided the cost of an American-made cable will not exceed the cost of a foreign-made cable by more than 10 per cent. The total cost of the cable is fixed at $2,000,000, and $300,000 is made immediately available for its construction. The three Cabinet officers are authorized to enter into negotiations and establish cable connection with lines running to Central and South American, the West Indies and islands in the Gulf of Mexico, the Caribbean Sea and the Pacific Ocean. A maximum rate of 25 cents a word is fixed for commercial messages between the canal zone and the mainland of the United States. Government and press dispatches are to be sent at reduced rates.

NEW ZEALAND TELEGRAPH POLES are the subject of a report from Mr. Dillingham, United States Consul-General at Auckland, New Zealand. He summarizes the situation as follows: "There is some diversity of opinion as to the relative merits of totara and silver pine timbers. Although silver pine has its advocates, the fact that it is practically unobtainable in longer lengths than 20 ft. renders it less useful than totara. Silver pine, though a short-grained wood, lasts well in the ground, but the experience of the post and telegraph department is that totara is in general the best New Zealand timber for telegraph poles, and it is almost exclusively used. If the pole to begin with is free from symptoms of dry rot and the sap entirely removed, its life is long, say, up to thirty years, in the ground. It is, however, a very weak timber for standing a strain, and unless the pole is large it is likely to snap in a gale or from a sudden jar of any kind. This weakness requires that for a line carrying a few wires a fairly large pole must be used. The quality of the soil is a factor in the durability of a totara pole and probably of any other class of pole. The Otago district, a limestone country, is the worst. Kawaka (New Zealand cedar) is also a very good timber, having an advantage peculiarly its own in that it will not burn. Black pine has been found durable in some cases, but it is liable in certain soils to be eaten into by a large worm."

NEW YORK FRANCHISE TAXES.—Mr. Elihu Root, ex-Secretary of War, has been engaged by the public service corporations who are fighting the New York special franchise tax law, and will, as counsel for these companies, make the argument in their behalf before the United States Supreme Court in Washington about the middle of January. Mr. Root is now at work preparing his argument and briefs. Upward of $18,000,000 in unpaid franchise taxes hinges on the decision which the court will make, as none of the companies of any consequence has paid anything on its taxes since the law became operative on January 1, 1900.

CONTROL OF THE TRUSTS.—It is stated from Washington that among those who are best acquainted with the President's views and purposes in regard to the solution of the trust problem, it is expected that in a message to Congress, after the holiday recess, he will urge the wisdom of requiring that all corporations engaged in inter-State commerce shall organize under Federal charters and thus pass under control of the general Government so far as their corporate capacity and behavior are concerned. This course will be the result of long study and exhaustive inquiry into the conduct of inter-State corporations, and their effect on the public in the matter of trade, prices, supply and demand, transportation and distribution.

ENGLISH POWER TRANSMISSION.—At the ordinary meeting of the Institution of Civil Engineers on Tuesday, the 22d of November, Sir Guilford L. Molesworth, K.C.I.E., president, in the chair, the paper read was "Distribution of Electrical Energy," by John F. C. Snell, M. Inst., C. E. A number of points were discussed. Diagrams accompanying the paper demonstrated the economical radii of supply by direct current at 500 volts for different loads transmitted and by the high-tension sub-station method, the results being that above the undermentioned distances the high-tension method is more economical, viz.: 250 kw, economical radius, 1.6 mile; 500 kw, economical radius, 1.25 mile; 1,000 kw, economical radius, 1.06 mile. With regard to the effect of storage at substations, the author believes that storage will be more largely resorted to in the future; and figures are given in support of this view. He then proceeded to discuss the economical limit of pressure for high-tension supply by underground cables, and gave curves to show that for general purposes in Great Britain 6,600 volts is, approximately, the economical pressure.

UNDERGROUND RAILROAD TRAFFIC.—The ability of electric traction to develop new patronage is well understood, but there is little doubt that the recent wintry weather has helped to increase traffic on the New York Subway, where travel is warm and cozy compared with that on the surface. The number of passengers carried on Subway trains now averages 275,000 per day, with a tendency to increase. For the first few days of operation the road carried nearly 350,000 passengers per day, but this dwindled to about 200,000 just before the Lenox Avenue line went into operation. That branch is a great boon to Harlem, and the traffic is again increasing as a result of the improved service which has developed business. In November Manhattan Elevated suffered a loss of only half a million passengers, which is at the rate of less than 20,000 per day. The New York City Railway Company's net loss on the surface tracks does not exceed 40,000 passengers per day; although the loss of long haul traffic on the main lines has been considerable, it has been largely made up by an accession of short haul business on the same lines and a great increase in the traffic on the cross-town roads. Hence, it appears that of the 275,000 passengers handled daily in the Subway, upward of 200,000 represent entirely new business, while it is certain that in a short time the two older systems will have recovered from various sources the traffic lost temporarily.

PRODUCTION OF PLATINUM.—The world's production of this useful metal ranges annually between 160,000 and 170,000 troy ounces, but the production of platinum in the United States in 1903 was only 110 ounces (worth $2,080), and even that was 16 ounces more than the output of the previous year. Russia is the fortunate country which produces about 90 per cent. of the world's platinum. The remainder comes mainly from Colombia, South America. The data is given by the United States Geological Survey. During the year 1903 the center of interest in platinum mining in the United States shifted from Shasta and Trinity Counties, California, to southern Oregon. There, in the neighborhood of Grant's Pass and Kerby, platinum and iridosmium are found in the placer gold. Associated with the platinum and gold is another heavy mineral called josephinite, which is a natural alloy of iron and nickel. It also has proved commercially profitable. It is interesting to note that $6,000 worth of platinum was obtained in 1903 in the form of slimes in the treatment of the copper ore and matte from this region. The imports of platinum during 1903 show how inadequate is our home production. The total value of imports amounted to $2,055,933, which were distributed as follows: Unmanufactured, 1,426 pounds ($328,103); ingots, bars, sheets and wire, 6,308 pounds ($1,591,941); vases, retorts and other apparatus, vessels and parts thereof for chemical uses, $128,890; articles manufactured of platinum, $6,999. The price of pure platinum in wholesale quantities at New York continued during the whole of 1903, as during the last seven months of 1902, at $19 an ounce.

LETTER TO THE EDITORS.

Measurement of Sparking Distances.

To the Editors of Electrical World and Engineer:

SIRS:—Having read Mr. J. B. Whitehead's letter in your issue of December 10, I find it necessary to make a further explanation relative to my paper on sparking distances, which was read at the International Electrical Congress at St. Louis. I have been making measurements of sparking distances off and on since 1891 and have repeatedly found that said distances corresponding to definite voltages were very much affected by the sharpness of the points employed. This fact, I believe, is not mentioned with reference to the A. I. E. E. table of sparking distances nor is the kind of needle points specified.

The main object of my paper, therefore, was to show the magnitude of the errors that might exist when needle points of different measured diameters were employed. An examination of my paper will, I think, show that the greatest care was used in these researches; all of the apparatus being calibrated to an accuracy of at least .2 per cent. Therefore, there is no possible question as to the correctness of the measurements made. In confirmation of this I might say that check tests were repeated at intervals of months and that said tests agreed with the former ones.

To point out briefly how the sparking distance varies with the nature of the points, I will state in the first place that a pack of No. 12 needles, the finest on the market, contains points varying all the way from .0002 inch to .002 inch. With 1,000 volts and points measuring .0002 inch, the sparking distance is about .040 inch, while with points measuring .002 inch, the distance is about .012 inch. Specially made points which look sharp under a magnifying power of 600 diameters, gave a spark distance equal to .052 inch.

Now with 6,000 volts a maximum spark distance is obtained by using points that measure about .0014 inch, and this spark distance is about 20 per cent. greater than the distance obtained with points measuring about .0005 inch or less.

So also for 10,000 volts, there is a diameter of point, namely, about .0018 inch, that gives a maximum distance.

At 20,000 volts the variation in spark distance due to different points in a pack of No. 12 needles, seems to be very small, comparatively speaking, namely, about 3 per cent. But at 30,000, 40,000 and 50,000 volts, the spark distance is greatly increased by using points that are made slightly blunt, measuring from .002 inch to .005 inch. Tests made with No. 12 needles generally gave quite uniform results at these higher voltages, but with blunter needle points the distances and variations were both greater.

The difference between the sparking distances at 40,000 and 50,000 volts of the A. I. E. E. table and mine is, therefore, probably largely due to a difference in the kind of points employed. Now, as by the use of sharper points, more consistent results can be obtained, I am of the opinion that the A. I. E. E. should redetermine the sparking distances, using either No. 12 needles or, better, standard points ground uniformly sharp for this purpose. As matters now stand, each person using the Institute table selects whatever kind of needles he chooses and so uniformity of results cannot be expected. The electrostatic capacity between the terminals of the apparatus also

seem to have an effect upon the results. There also may occur unobservable static discharges in the transformer which will have a tendency to very much increase the sparking distance. Finally, if tests are being conducted with current obtained from commercial lighting and power circuits, accurate determinations of voltages by the sparking distance method cannot be made.

The statement made by Mr. Voege, and reiterated by Mr. Whitehead, that the sparking distance above 10 cm. is independent of the form of the electrode, is not strictly correct. Several years ago I was asked to assist in some spark distance measurements in connection with one of the first 200,000-volt transformers made in this country. Present were a number of noted engineers, and we found that at 200,000 volts the sparking distance was considerably affected by the kind of electrodes.

I expect to continue my investigations, going up to 100,000 volts. This subject to sparking distances corresponding to different voltages is a complicated one, and many separate tests made with widely different apparatus will have to be conducted before we will know definitely how accurate is this method of determining voltages.

In the *Electrotechnische Zeitschrift* for November 10, is an article by Mr. Grob. The author claims that sparking distance is very much affected by capacities between the terminals of the apparatus which have a tendency to produce resonance.

PITTSBURG, PA. HENRY W. FISHER.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Alternating-Current Commutator Motors.—NIETHAMMER.—An illustrated discussion of several new types of single-phase commutator motors. He deals first at some length with the series motor of the General Electric Company. Brown, Boveri & Co. make a repulsion motor for single-phase traction, regulating being obtained exclusively by displacement of the brushes. A motor of the Oerlikon Company is then described which can be run either as a direct-current, series motor or as a single-phase, series motor, or as a repulsion motor, or as a compensated series motor; it was recently noticed in the Digest. Lahmeyer & Co. build besides the Schüler motor, also a compensated repulsion motor, as shown in Fig. 1. The

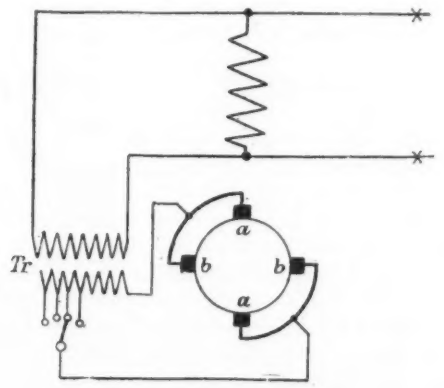


FIG. 1.—REPULSION MOTOR.

commutator is provided with two sets of brushes, *a a*, in the direction of the stator field, *b b*, perpendicular to this direction; each brush of one set is connected with one brush of the other set, as shown in the diagram. The brushes are connected to an adjustable transformer, *Tr*, the primary winding of which is connected to the network. The method of operation is essentially similar to the compensated series motor, as built by the Union Electric Company; it is, however, in principle a shunt motor. For stationary purposes, for instance, for elevators, the Alioth Company builds the Fyn motor, as shown in Fig. 2. It is of the same general type as the Schüler motor, but it has besides the direct-current winding, *g*, also a three-phase winding, *d*, which is connected to three slip rings. The motor starts as a repulsion motor whereby the rotor current between the brushes can be adjusted by a resistance, *B*. This is made use of, however, only for motors beyond 5 hp. With increasing speed the three-phase starting resistance, *A*, is gradually short-circuited until finally the motor runs as a pure induction motor without commutator. The stator has a three-phase winding of which always only two phases are used. Reversal of the direction of rotation is obtained by the switch, *J*. The efficiency at full load is 70 per cent. for 1 hp and 75 per cent. for 10 hp, the power factor being 74 and 82 per cent., respectively. The starting current for full torque is 70 to 80 per cent. of the normal current; for starting with double torque it is necessary to use 1.4 to 1.6 times the normal current. By using a special excitation winding on the stator, which is displaced by 45° against the main winding, and connecting it with the commutator brushes, the power factor may be made 0.9 or more, but the efficiency decreases.—*Zeit. f. Elek.* (Vienna), December 4.

Magnetic Flux Distribution in Toothed-Core Armatures.—HELE-SHAW, HAY AND POWELL.—The first part of an illustrated paper read before the British Institution of Electrical Engineers. The investigation is based upon the fact that the laws which govern the distribution of magnetic flux in space of two dimensions are identical

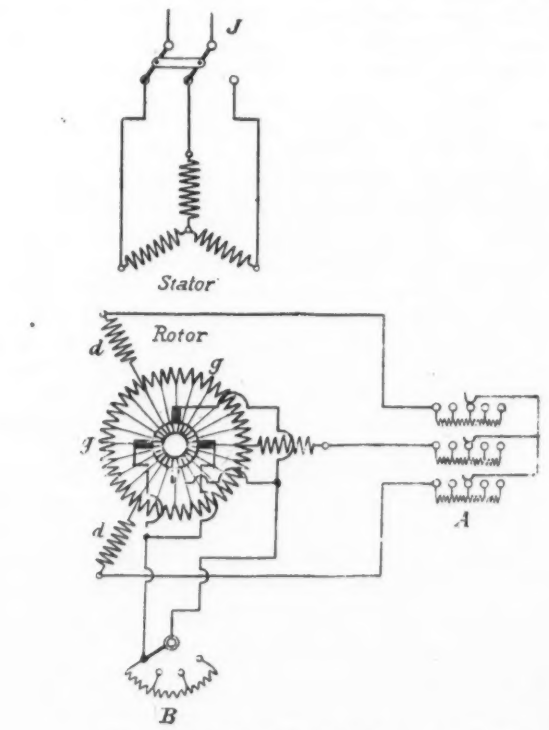


FIG. 2.—DIAGRAM OF MOTOR CONNECTIONS.

with those which apply to the stream-line motion of a perfect incompressible fluid in two-dimensional space. In order to make the stream-lines of the fluid visible the authors use a colorless liquid into which are injected thin color bands, consisting of the same liquid mixed with a suitable dye. In reality there exists no perfect fluid, every actual fluid being more or less viscous. But Stokes has shown that when any viscous liquid is made to flow in a very thin layer between parallel bounding walls, the stream-lines obtained are identical with those of a perfect liquid. In order to find some analogy for magnetic permeability which would enable the study of the flux distribution in regions having different permeability, the authors make use of the fact that when a viscous liquid flows in a thin parallel layer, the quantity of liquid passing per second across a plane of unit length drawn normally to the stream-line is, for a given pressure gradient, inversely proportional to the cube of the thickness of the liquid layer. Hence, if the liquid is made to flow

through several regions of different thickness, the ratio of the cubes of the thicknesses gives the ratio of the permeabilities in the corresponding magnetic problem. The practical method employed consisted in coating one of the thick glass plates forming the slide with a thin layer of paraffin wax, and then forming a cavity or cavities of the required shape by carefully scraping away the wax over certain areas. These areas over which the liquid layer had a greater thickness, represented the regions of high permeability. The liquid used was glycerine and the dye for mapping out the stream-lines was a mixture of aniline dye with permanganate of potash. The method was applied to study the air-gap reluctance by its hydrodynamic analogy, but the result thus obtained was afterward supplemented by tests of an actual dynamo. The investigation of air-gap reluctance referred first to the fringing problem, and then to the problem of the flux distortion brought about by armature teeth. The results of the authors are in good agreement with the formula of Carter (ELEC. WORLD & ENGINEER, Vol. 38, p. 884). The paper is to be concluded.—Lond. *Elec.*, November 25.

Oil for Transformers, Switches, Etc.—E. K. SCOTT.—An article on the preparation of oil to be used in transformers, etc. There are various methods of drying, but perhaps the best one is to place the oil in a large tank having a resistance coil suspended in the center. After the current has heated up the oil, air is brown through it from a motor-driven compressor, the air having been first thoroughly dried by passing it over chloride of lime. As the small bubbles pass upward through the oil they take up any moisture that may be present. In the case of a very large tank, it is as well to also agitate the oil mechanically, so as to insure all of it coming into contact with air. After drying, a flashing test is made, and this, of course, varies according to the voltage to be employed. It may be taken, however, that no oil is considered satisfactory which will not withstand at least 30,000 volts alternating between two flat surfaces 1½ in. in diameter and ⅕ in. apart. Oil is an absolute necessity for high-tension switches. In very cold weather the oil may become thickened. As a cure for this the General Electric Company recommends tetrachloride of carbon with oil.—Lond. *Elec. Rev.*, December 3.

REFERENCES.

Design and Construction of Small Dynamos and Motors.—POOLE.—The third in the series of articles on the construction and design of small motors and generators. Additional tables and rules are given. The winding of armatures with lap or wave windings, connection of armature coils to commutators, pole piece dimensions and armature length, and field magnet dimensions are considered.—*Amer. Elec.*, December.

Synchronizers.—HOWETT.—An illustrated description on the construction and use of synchronizers for connecting alternating-current machines in parallel.—*Power*, December.

Speed Control.—MEADE.—An illustrated description of the system of multiple-voltage control of direct-current motors.—*Power*, December.

Compound Dynamo.—A mathematical article, illustrated by diagrams, on the graphical determination of the characteristics of compound dynamos.—*L'Eclairage Elec.*, November 26.

LIGHTS AND LIGHTING.

Cadmium Amalgam Lamp.—LUMMER AND GEHRCKE.—A description of a lamp which is an improvement on one made some seven years ago by Gumlich, who constructed a vacuum lamp containing cadmium amalgam instead of mercury. The lamp offered the advantage of adding the highly luminous cadmium lines to the spectrum of the mercury. But it failed owing to its short life, breaking after a few experiments, whereas a good mercury lamp may last for years. Since Heraeus has succeeded in constructing mercury lamps of quartz, it suggested itself to try this material for the construction of amalgam lamps. This attempt has been successful. The lamp consists of two vertical tubes, *A* and *B*, joined by a horizontal one, as shown in Fig. 3. Both tubes are bent twice at right angles below, and end in somewhat narrower tubes, *A'* and *B'*. At *a* and *b* two iridium wires are introduced. The lamp is filled through the top of *B*, which is then fused. Connection is made by means of iron wires dipping into *A'* and *B'*, which are fixed in with shellac and Chatterton cement. The amalgam used by the authors contains 14 parts of cadmium to 100 of mercury. At ordinary temperatures it is a soft mass, which on slightly heating becomes as fluid as mercury and is easily worked with. The oxidation of the cadmium is so slight as to be innocuous. The lamp may be lighted by shaking, but a better method is by using a lighting device, as in the Hewitt mercury lamps. A current flowing through a parallel inductance at 110 volts pressure is suddenly interrupted. It thus generates a high potential, which suffices to bridge the gap between the amalgam electrodes. After that the lamp continues to burn steadily with one or two amperes. It is, however, necessary to heat the lamp externally with a Bunsen burner before starting or restarting it. After some use, it is necessary to keep the lamp steadily heated up in that way to make it burn continuously. But the lamp may be brought back to its original condition by renewing the exhaustion.—*Zeit. f. Instrumentenkunde*, October; abstracted in Lond. *Elec.*, December 2.

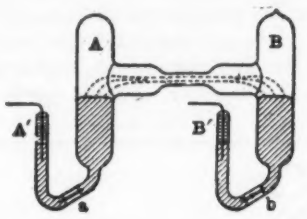


FIG. 3.—CADMIUM AMALGAM LAMP.

POWER.

Twin City Rapid Transit Power Station.—KNOWLTON.—A description of a new 35,000-kw plant for the traction system of St. Paul and Minneapolis, at present equipped with three 3,500-kw, three-phase, 34⅔-cycle, 13,200-volt alternators, direct-connected to vertical cross-compound condensing engines. The station area is equivalent to 2.3 sq. ft. per kw of rated capacity. There are 18 boilers of 550 hp, each arranged in two rows, each row served by a line of reinforced concrete overhead coal bunkers having a combined capacity of 2,800 tons. There are three continuous bucket coal conveyors of 75 tons' hourly capacity with lump coal. The boilers are built for a working pressure of 200 pounds, and then are equipped with the Roney stoker and with a superheating device designed to superheat 120° F. Two 225-ft. stacks, 16 ft. in internal diameter at the top, take the gases of combustion. There are two 12 x 16 x 18-in. horizontal duplex service pumps and two 14 x 10 x 24-in. vertical feed pumps, and an open type feed-water heater capable of heating 350,000 pounds of water per hour from 60° to 210° when supplied with exhaust steam atmospheric pressure. The condensers are of the vertical single-acting Blake jet type, one to each engine, with 48 x 24-in. air cylinders and 18 x 24-in. steam cylinders, and they are arranged to exhaust, when desirable, into the engine receivers against a maximum back pressure of 40 pounds. Oil for lubrication is distributed from an overhead tank under pressure maintained by means of compressed air at 40 pounds and two oil filters are employed in the system. A 70-ft. span, 40-ton, four-motor electric traveling crane travels the length of the engine room. The steam header, 16 in. in diameter, is supported in the boiler room against the partition wall and the 14-in. engine leads are carried through the engine room basement through 16-in. direct separators.—*Eng'ing Record*, December 10.

Electric Power in a Gas Plant.—BAEHR.—A paper presented to the American Gas Light Association discussing the gas engine as a driver of electric generators for conditions existing in a typical American gas works. The object is to show by actual test the steam consumption of a typical gas works under normal conditions and to prove the economy to be gained by the installation of a local gas engine-driven electric plant replacing certain steam engines and steam pumps by others which can be practically operated by electric motors. While the first cost of a gas engine plant is higher in this case than that of a steam plant, there is a considerable saving over the steam installation per year to be effected with it. The electrically-driven plant with interest and depreciation is estimated to pay for itself in from 8 to 10 years.—*Progressive Age*, December 15.

Power Plant of Office Building.—BUNNELL.—An abstract of a paper read before the American Society of Mechanical Engineers on the power plant of the tall office building. The author gave mainly a comparison between compound and four-valve simple non-condensing engines, as used in tall office building power plants. His deduction was that compound engines for this service often give results inferior to those of the single-cylinder engines with a

better valve gear, costing considerably less to construct.—*Iron Age,* December 15.

REFERENCES.

Forcing Capacity of Fire-Tube Boilers.—DEAN.—A substantially full reprint of a paper read before the American Society of Mechanical Engineers, giving the results of ten tests of different fire-tube boilers, one of which was operated at 125 per cent. above normal rating with 4.44 sq. ft. of heating surface per horse-power and another of which gave an equivalent evaporation from and at 212° F. of 11.32 pounds per pound of dry coal.—*Eng. Record,* December 10.

Value of Water Powers.—MAIN.—An abstract of a paper read before the American Society of Mechanical Engineers, which included a method of estimating the value of an undeveloped water power privilege.—*Eng. Record,* December 10.

Losses in Non-Condensing Engines.—STANWOOD.—An abstract of a paper read before the American Society of Mechanical Engineers covering the effect of clearance, of compression and release and of varying loads, the last having a practical bearing on the conditions of the isolated plant.—*Eng. Record,* December 10.

TRACTION.

Rapid Transit and the Electric Locomotive.—KNOWLTON.—An article discussing the part the electric locomotive will play in rapid transit problems. The author has no doubts as to the ultimate certainty of the electric locomotive supplanting its steam prototype; but he considers that it is a great mistake to assume that the steam locomotive is at present on the road to the scrap heap. He points out the limitations attending the application of electricity to general railway service, and the obstacles that must be overcome before the steam locomotive becomes extinct. A comparison is made between the electric locomotive of the New York Central Railroad and a typical suburban steam passenger locomotive. The great advantage of the electric over the steam-driven machine is pointed out.—*Amer. Elec.,* December.

Traction Diagrams.—KADRNOZKA.—An article, illustrated by diagrams, describing the graphical determination of tractive force, power, speed, etc., on a given road for a given train.—*Elek. Bahnen,* No. 21, November.

Three-Phase Traction.—VALATIN.—Continuations of the fully-illustrated detailed description of the Valtelina road.—*Elek. Bahnen,* Nos. 21, 22, November.

Underground Electric Railway Work in Paris.—An illustrated description of new work on the Paris Metropolitan. A map of the complete and proposed subway lines is given and the work on the southern section is described in some detail. Descriptions are also given of the new Père Lachaise and Barbé's sub-stations.—*Amer. Elec.,* December.

Rail Joints.—An illustrated description of new rail joints, used on the Berlin street railways.—*Elek. Zeit.,* November 24, 27.

Cable Roads.—JORDAN.—An account of results obtained with the cable on the Mendel road and its care and maintenance.—*Elek. Bahnen,* No. 22, November.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

REFERENCE.

Lay-out and Construction of a Modern Sub-Station.—SWENSON.—An illustrated article describing in detail the Ohio Street sub-station of the Chicago Edison Company and enumerating the considerations which influenced the design. A peculiarity of the design is that the storage batteries are placed on the second floor of the stations, thereby leaving the basement free for all cable runs, high-tension bus and air chamber, mounting field rheostats, starting resistances, a heating system and a well-designed drainage system, which would be impracticable were the battery in the basement, as is often the practice.—*Amer. Elec.,* December.

WIRES, WIRING AND CONDUITS.

Heating of Underground, Three-Phase Cables.—APT AND MAURITIUS.—An account of tests of the heating of three-phase cables. The first tests were made with cables with fibre insulation, built for voltages up to 1,000. If not more than two such cables are placed closely together in the earth, and if the temperature shall not rise more than 25° C., the maximum currents to be allowed for different cross-sections are given in the following table:

Q	J	$\frac{J}{Q}$
sqmm.	Amperes per phase.	
(3 x 6)	(50)	(8,33)
3 x 10	65	6,5
3 x 16	85	5,31
3 x 25	110	4,41
3 x 35	135	3,86
3 x 50	170	3,4
3 x 70	205	2,93
3 x 95	245	2,58
3 x 120	280	2,33
3 x 150	320	2,13
3 x 185	365	1,97
3 x 210	395	1,88
3 x 240	430	1,79
3 x 280	470	1,68
3 x 310	500	1,61

These are maximum values which should never be surpassed. The authors then tested cables with paper insulation built for a maximum voltage of 6,000. If the maximum rise of temperature allowed is again 25° C., the maximum currents allowed are given in the following table:

Q	J	$\frac{J}{Q}$
sqmm.	Amperes per phase.	
(3 x 6)	(50)	(8,34)
3 x 10	60	6,00
3 x 16	73	4,57
3 x 25	90	3,60
3 x 35	108	3,09
3 x 50	130	2,60
3 x 70	155	2,22
3 x 95	185	1,95
3 x 120	210	1,75

It will be seen that less current per cross-section is allowed for high-tension cables than low-tension cables. The highest permissible current depends on the question whether the increased temperature acts on the insulating materials so as to decrease the perforation voltage. The fact that with increasing temperature, the insulation resistance also decreases, is of less interest, since a high insulation resistance is now in general not considered to have anything to do with the quality of the cable. The authors give some results of tests of the change of perforation voltage with increasing temperature. These results are given in form of curves and show that the perforation voltage curve has a maximum for fibre insulation cables, the position of the maximum depending essentially on the material with which it is impregnated. With India rubber cables, the perforation voltage decreases continuously with increasing temperature.—*Elek. Zeit.,* December 1.

REFERENCES.

Calculation of Cross-Section.—WERNER.—An article, illustrated by diagrams, on the calculation of the cross-section of the line for three-phase transmission.—*Elek. Anz.,* November 24.

Conduit Work.—MCMACKIN.—An illustrated article containing many practical hints on the installation of iron conduit in buildings already built and of fire-proof construction.—*Amer. Elek.,* December.

ELECTRO-PHYSICS AND MAGNETISM.

Luminescence.—NICHOLS AND MERRITT.—In a continuation of their studies of luminescence the authors have investigated the influence of light upon the absorption of fluorescent solutions and have detected a well-marked increase in absorbing power during fluorescence. In attempting to interpret the results of this investigation they were led to suspect that fluorescence is accompanied by a temporary dissociation of the active molecule or ion similar perhaps to the dissociation produced in gases by the action of Röntgen rays, and that the change in absorption during fluorescence is due to the presence in the solution of the products of this dissociation. Since such dissociation in all likelihood would bring about a decrease in electrical conductivity, the authors studied the influence of light upon the conducting power of fluorescent solutions and obtained, in fact, conclusive evidence of an increase in electric conductivity during the fluorescence in the case of each of five substances tested by them.—*Phys. Rev.,* December.

REFERENCES.

N-Rays.—An article by Wood presenting some arguments against the real existence of N-rays and suggesting that the experimenters who obtain results with N-rays and those who do not try a series of experiments together. Blondlot replies to some arguments of Wood.—*Scientific Am. Supplement,* December 17.

N-Rays.—BREYDEL.—An article on the nature of N-rays and N^1-rays. He defines these two kinds of rays as "directions along which is transmitted a vibratory movement of concentration or expansion resulting from the reaction of the received excitations." An electri-

fied body may be considered as a series of radiations going from it to the outside or converging to it from the outside.—*L'Eclairage Elec.*, November 26.

ELECTROCHEMISTRY AND BATTERIES.

Materials for Resistors.—FITZ GERALD.—The author uses the term "resistor" for any substances which offer resistance to the passage of an electric current, just as a conductor is a substance conducting current. He deals with the use of various materials, and especially carbon, in electric resistance furnaces. The resistance of a resistor may change considerably during the run, but in order to work economically with an electric furnace it is usually important that the maximum power available be used throughout the furnace run, and if the resistor changes its resistance it is necessary to provide some means of regulating the voltage. In order to use the full available power throughout the run, the maximum and minimum voltages attainable must have to each other, the ratio of the square roots of the maximum and minimum resistances of the resistor. If the resistor consists of carbon and the resistivity is reduced by about 50 per cent. when heated to a high temperature, the ratio of the maximum and minimum voltages required is 1.41. If, however, the temperature of the resistor is higher than the carbon composing it has ever been at before, another factor enters in. The physical stage of carbon is permanently changed by heat. In addition to the physical change there are chemical changes, if, as usually is the case, there are impurities present. Moreover, the properties of different kinds of carbon that are raised to the graphitizing temperatures vary greatly according to the kind of amorphous carbon used. Thus the properties of carbon rods made from petroleum coke and lampblack are decidedly different. Usually a solid carbon rod is not a satisfactory resistor, particularly if working on a large scale, since to generate energy at a sufficiently rapid rate to obtain a high temperature it is necessary to use a current of great amperage and low e.m.f. But if the carbon is broken up into many pieces the resistance of the mass is greatly increased, because of the number of points of contact which have a high resistance. It is evident that it the number of points of contact is increased, the resistance of the resistor will be increased, other things being equal. The author discusses at great length the use of a granular carbon as resistor and gives the results of various experiments. Other things equal, preventing the radiation of heat from a carbon resistor causes a decrease in its resistance. If pressure is applied to the resistor the resistance decreases, and after removing the pressure the resistance is lower than it was before applying pressure. Of two granular carbon resistors, each composed of grains of uniform size, the coarser-grained resistor has the lower resistivity. If the same pressure is applied to a coarse-grained and fine-grained resistor, the decrease in resistivity produced is greater in the former than in the latter. The influence of pressure on a granular carbon resistor must always be kept in mind when a high column of granular carbon is used. Where resistors of greater resistivity than can be obtained from granular carbon are required, it is necessary to mix with the carbon some other substances of high resistivity. The use of such a resistor is limited by the nature of the substance mixed with the carbon, since no other substance than carbon can withstand the highest attainable temperatures. The substance chosen should be very refractory, and for that reason a silico-carbide or carborundum seems at the present time to be most likely to give satisfactory results.—*Electrochem. Ind.*, December.

REFERENCE.

Conductivity of Dilute Solutions.—GOODWIN AND HASKELL.—An account of measurements of the electrical conductivity of very dilute (0.0001 to 0.002 normal) hydrochloric and nitric acid solutions. The equivalent conductivity for infinite dilution is 380.1 for hydrochloric acid and 377.0 for nitric acid.—*Phys. Rev.*, December.

UNITS, MEASUREMENTS AND INSTRUMENTS.

High-Frequency Alternating Currents from Direct Current.—In a circuit in parallel with an electric arc and containing capacity and self-induction, an alternating current is produced of relatively high intensity, and of very high frequency (about 8,000 alternations per second). The author uses this fact for operating induction coils. In order to get a high intensity, it is preferable to use several arcs in series, as shown in Fig. 4, where *a*, *b*, *c* are three enclosed arc lamps, *d* a condenser of about 9 microfarads, *h* a choking coil and *e* the primary of an induction coil, *g* being the air-gap in the secondary. With three arcs, the current in the condenser circuit was 13 to 15 amp.—*Elek. Zeit.*, December 1.

REFERENCE.

Testing Magnetic Properties of Iron.—An illustrated description

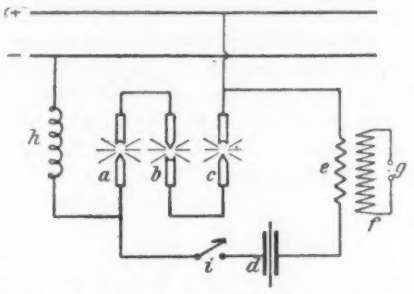


FIG. 4.—HIGH-FREQUENCY CURRENTS FROM DIRECT CURRENTS.

of several small instruments used in Germany for testing the magnetic properties of iron.—*Scientific Am. Supplement*, December 17.

TELEGRAPHY, TELEPHONY AND SIGNALS.

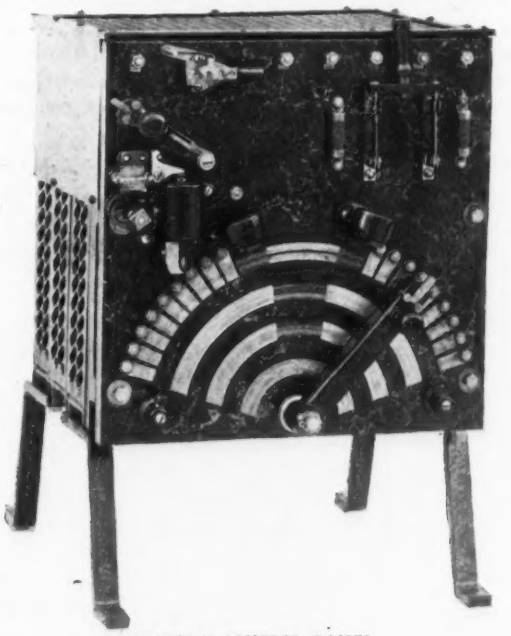
REFERENCES.

Telephone System.—An illustrated article on the new municipal telephone system of Hull, which is the fifth English town working a municipal exchange. There are now over 700 subscribers actually connected, while the switchboard has accommodations at present for 2,000 subscribers, but can be extended hereafter to provide for 5,000 subscribers.—Lond. *Elec. Eng.*, December 2.

Common Battery Central Office.—O'BRIEN.—An article, with diagram, giving the various tests made in common battery systems, and describing the outfit usually furnished in the central office for carrying out the various tests.—*Amer. Elec.*, December.

Reversing Armature Control Panel.

The Ward Leonard Electric Company, of Bronxville, N. Y., has designed the reversing armature controlling panel shown in the cut herewith. This panel is built to fulfill United States Government specifications. The panel is complete with reversing regulator, switch, fuses and overload circuit-breaker. The overload circuit-breaker is single-pole, but it cannot be closed upon short-circuit or



ARMATURE CONTROL PANEL.

overload. The circuit upon the regulator is never made or broken on the controlling arm, contact shoes or stationary segments, but is always made by an independent, spring actuated, renewable, circuit-closing switch, which opens the circuit with a quick break and magnetic blow-out.

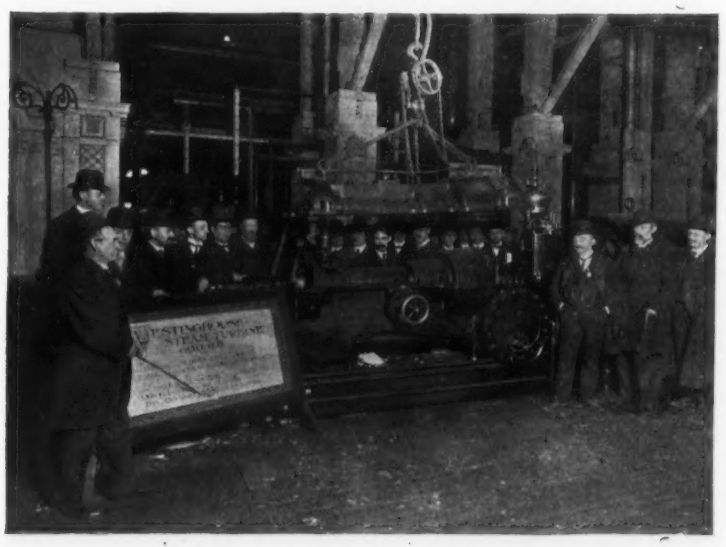
The resistance is made up of Ward Leonard enameled resistance units. Sufficient resistance is furnished in this controller to reduce the speed 75 per cent. The cut shows a 3-hp, 110-volt controller.

Trolleys at Malaga, Spain.

U. S. Consul Buck, at Malaga, Spain, writes: "The projected railway between this city and Velez-Malaga, the next largest pueblo on the east, seems near realization at the present writing. In several previous reports this line has been mentioned as being in an embryo state, but recently the scheme appears to have assumed shape. The prime mover of the enterprise is an American, but the capital invested will probably be mostly Belgian and Canadian. Last week the promoters visited Malaga and closely inspected the proposed route. Active construction work is expected to begin before the end of the year. The chief function of the line, as now contemplated, will be the conveying of the immense quantity of sugar cane, olives and olive oil, almonds and raisins, which are now brought into this city on mule back. A passenger service will also be established, but the freight service is viewed as the more profitable. The only obstacle now in the way is the consent of the local authorities to the use of the right of way over the line of an old railway used in the construction of the harbor wall. Another line to Coin, a small town about 30 miles to the southwest of Malaga, is also contemplated by the same promoters, but as the concession is still "hanging fire" in Madrid, it will probably be many months before this idea assumes definite shape. Both these lines, when built, are expected to open up the surrounding country to a considerable degree and to bring the many small but thickly populated villages in close touch with this, the capital city of the province. Steam is the motive power mentioned in the concession for the Velez-Malaga line, but the projectors are desirous of substituting electricity. The Coin road will be electric.

A Steam Turbine Record.

A memorable incident of the morning following the close of the St. Louis Exposition was the formal shut-down and inspection of the 600-hp Westinghouse steam turbine generating unit in the Palace of Machinery after a continuous run of over 3,962 hours—a performance which is claimed to have no parallel in steam turbine history. This machine was started on its long run at 9.20 o'clock on the morning of Monday, June 20, shortly after its installation at the Fair, and was stopped at 11.32 o'clock on the morning of Friday, December 2. During the five and a half months that the unit was in operation it supplied current for light and power



600-HP WESTINGHOUSE-PARSONS STEAM TURBINE, PALACE OF MACHINERY.

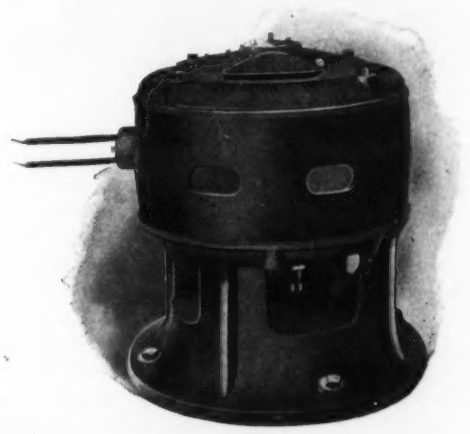
throughout the Westinghouse exhibits in the Palaces of Machinery, Electricity and Transportation. Charles F. Foster, chief operating engineer of the Exposition; H. M. Holman, supervising engineer at the Government Exposition gas engines tests, formerly president of the St. Louis Board of Public Works, and a number of Westinghouse representatives, including Wallace Franklin, of Detroit; C. C. Chappelle, of Chicago, and W. K. Dunlap, managing director of the Westinghouse exhibits, were present when the engine was stopped. They will be identified as members of the group in the photograph. It was found to be in perfect condition, and there were no signs of wear, the bearings still retaining the tool marks as they had come from the shops.

There have been at least two instances on record in America in which piston engines have been run continuously for about the same length of time as that of the record run of the Westinghouse turbine. The remarkable feature of the turbine run, of course, was the maintenance under load of a speed of 3,600 r.p.m. for such a long period. From 8.30 o'clock in the morning to 10.30 o'clock in the evening, the load carried throughout the Exposition varied from 25 per cent. underload to 25 per cent. overload. The total number of revolutions almost touched the billion mark—855,792,000.

Vertical Single-Phase Motors.

The Wagner Electric Manufacturing Company, of St. Louis, has just added to its line of single-phase, alternating-current power motors a very neat type of vertical motor, an illustration of which appears herewith. The special field of application for such a motor is in driving centrifugal pumps, and work of similar character.

In its general construction this motor corresponds electrically to the well-known forms of Wagner single-phase motors heretofore



VERTICAL MOTOR.

on the market. Mechanically the introduction of ball bearings, etc., is a distinguishing feature, resulting in an excellent efficiency and quiet running of the motor. The motors are now made in 10 and 15-hp sizes, for 60-cycle service. The windings are for 110, 220 or 500 volts, and the speed is 1,150 r.p.m.

A New Power Plant for An Old Iron Works.

The Quintard Iron Works Company, one of the oldest plants of the kind in this part of the country, has had plans and specifications prepared for the building and equipment of a complete power plant for the generation of light and power, for its entire works, located on the East Side in New York City, extending from Eleventh to Twelfth Streets, and from Avenue D to Dry Dock Street. These works, which have been operated for many years under their present name and under the same management, have always had the reputation of turning out work of the highest quality. Many equipments which have become of historic as well as engineering interest have been built in these shops. The engines of the United States battleship *Maine*, which was blown up in Havana harbor prior to the late war with Spain, were turned out by this iron works.

The new power plant will consist of a two or three-story brick and steel building covering an area of about 35 ft. by 60 ft., which is now occupied by a one-story storeroom for raw materials and castings. In the power plant building coal will be stored on the second floor, and the ground floor, which will be divided into boiler room and engine room respectively, will contain the boilers, feed pump and steam generating accessories, and the engines with their direct-connected generators, steam piping, feed-water heater, air compressors, oil separator and switchboard.

The capacity of the electric plant as laid out will be 150 kw in all, with provision for an additional unit of 60 to 75 kw if needed later on. Besides the equipment required for this electric plant, there will be installed a complete heating system for the office building and entire works. At present some electric motors are being used

in the carpenter, pattern and machine shops and it is planned to eventually extend the use of electric drive to the boiler and blacksmith shops.

The designs and specifications for the power plant and heating system have been prepared by the firm of Bates & Neilson, in whose hands has also been placed the work of motorizing the machine tool equipments.

Solder for Electrical Purposes.

A new solder known as "Solderene" is being introduced for electrical purposes. It is a soft solder, and, unlike most preparations of this sort, it is claimed to have the adhesiveness of hard solder. In experimental work a copper rivet has been soldered to a piece of brass, and a piece of iron has been soldered to a piece of brass, and the juncture of the two resisted all manual efforts at separation. It contains no acids, and nothing is necessary in the soldering of two metals but the application of the Solderene to the

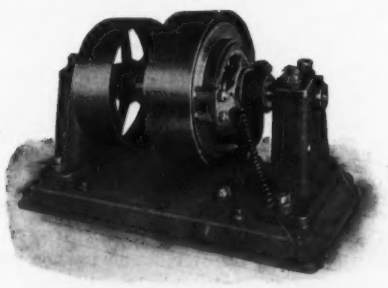
SOLDER FOR ELECTRICAL PURPOSES.

parts to be joined. Another remarkable illustration of its power is the putting together of the heads of two wire nails, which subsequently resist all ordinary efforts to disconnect them.

Because of its admirable qualities, combined with the ease of operation, Solderene is particularly adapted to electrical work. A number of electrical companies are making use of it. Some motor manufacturers have found it answers the purpose of hard solder for soldering connections. It is said that it is a very economical preparation both in saving time and because there is no waste, and that a very little of it is used at a time. It is being put on the market by W. Green & Co., 6½ Maiden Lane, New York.

Electric Clutch.

One of the latest entries into the field of electrically-operated machinery is the Williams electric clutch, a cut of which is shown herewith. The driving principle of the clutch consists in the clamping of a number of discs by magnetic action. The multipled discs brought in intimate contact by their magnetization gives these clutches great driving power, as compared with their size, and the consumption of current in the energizing coil is so small as to be negligible. A



ELECTRIC CLUTCH.

50-hp, 100-r.p.m. clutch requires approximately ½ amp. at 110 volts.

The actuating coil is mounted concentrically with the shaft bore of the clutch and is enclosed in an oil and water-proof metallic case. This in turn is enclosed in the clutch proper, which saves it from damage from external sources. This coil is insulated in accordance with the best electrical practice, being given a break-down test of 2,200 volts alternating current for 110 and 220-volt work and 5,000 volts alternating current for 500-volt service.

In these clutches, the objectionable residual magnetism causing the clutch to hold for a short period after the current has been cut off, has been entirely overcome, and they will take hold and let go more promptly than any mechanical clutch can.

Two types are built: those in which the current is left on while the clutch is in operation, and those in which the current is only used to throw the clutch on and off. The same principle is also made use of in a safety device for stopping heavy tools or machines in case of accident to the operator. The pressing of a button or the least pressure on a safety cord enables the heaviest machinery to be brought to practically an instantaneous standstill in case of a workman being caught and at the same time indicates through an annunciator in the superintendent's or manager's office the machine or section of factory affected.

This apparatus is being placed on the market by the Williams Electric Machine Company, of Akron, Ohio.

Independent Telephone Convention Notes.

A report appears elsewhere in this issue of the proceedings of the Interstate Telephone Association in Chicago, the opening work of which was telegraphed last week and appeared in our issue of December 17. We now give below some miscellaneous convention notes of doings at the Auditorium.

R. R. GENGE represented Francis Beidler & Co. and gave all callers information concerning cedar telephone poles. Many were favored with the presentation of souvenir thermometers, as mementos of the occasion.

THE ERICSSON TELEPHONE COMPANY filled room 618 with an attractive display of telephone apparatus. The instruments were connected up in working order. Among the instruments shown were the four-party selective, special ground farm line apparatus, and desk and table sets. Mr. J. H. Montague, manager sales department, and Mr. Pierce, Western representative, were present to explain the apparatus.

GRAY TELEPHONE PAY STATION.—George A. Long, engineer for the company, explained the simplicity and other features of the company's products in room 614, where quite an attractive exhibit was arranged.

THE AMERICAN STEEL & WIRE COMPANY occupied room 644 with an attractive exhibit of telephone wire and other of its products of interest to telephone men. A punchbowl was sparingly patronized by callers. C. A. Wanner, W. A. Gairns, George Chandler, F. J. Conklin and W. C. Bogue received visitors. To find room 644 it was simply necessary, after leaving the elevator, to follow the footprints tacked to the floor.

MR. H. LOUD interested many in showing the features of the block manufactured by the Walton Self-Locking Block Company, of Boston, Mass.

THE ELLIOTT ADDRESSING MACHINE COMPANY was ably represented by Mr. A. R. Baker, Western representative. Machines for addressing telephone bills and envelope sealers formed the display.

J. E. GOODWIN was in charge of the exhibit of the Kester Electric Manufacturing Company. Included in the display was the clock made of nearly 20,000 pins, which was exhibited at the World's Fair. Samples of soldering paste and self-fluxing solder were distributed to those interested.

THE CENTURY TELEPHONE CONSTRUCTION COMPANY was represented by Gustav F. C. Bauer, of the sales department, and W. W. Kidney, engineer.

MILLER ANCHOR COMPANY.—F. B. Miller and G. H. Miller, of the Miller Anchor Company, cared for a very complete exhibit of the different types of anchors put on the market by the firm.

MR. C. S. MATTHEWS, junior member of the firm of W. N. Matthews & Brother, had charge of the exhibit of Strombaugh guy anchors.

THE CENTRAL TELEPHONE & ELECTRIC COMPANY exhibited their special long-distance telephone. The exhibit was cared for by J. S. Cuming, president, and W. F. Gradolph, engineer of the company.

DR. G. W. WILDER, of the Armour Institute of Technology, was present with books and pamphlets outlining the course in telephony as developed by the Institute.

CONTROLLER COMPANY OF AMERICA.—Several were fortunate enough to receive one of the souvenir tape measures distributed by Mr. H. D. Stroud, of the Controller Company of America.

FIBRE CONDUIT.—A display of fibre conduit, manufactured by the Fibre Conduit Company, was in charge of W. W. Smythe, Western manager.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—The prices of stocks were steady on general recoveries, though speculation was of a more restricted character. Easy money offset the unfavorable effects of continual gold shipments and withdrawal of funds to the Pacific coast. Railroad news continued favorable and industrials were influenced by good reports of the steel trade, renewed support appearing in United States Steel issues. Bonds are firm and active in anticipation of January demands for investment. Greene copper, one of the most prominent stocks traded in on the curb market, broke badly during the raid early in the week, but, on the other hand, Amalgamated Copper resisted the attacks and showed a rallying tendency. Among the electric securities the two Westinghouse issues stand alone with net gains at the end of the week's business. Common is 5 points higher, closing at 183½, and preferred 4½ points, 194½ being the last quotation. General Electric touched 189½ and closed at 186½ ex-div. Allis-Chalmers common is 1⅜ points lower and preferred 6 points, the closing prices being 17 and 62, respectively. Brooklyn Rapid Transit is 3¼ points lower, closing at 59¾, and Metropolitan Street Railway lost 1 point, the last quotation being 120½. Manhattan Elevated closed at 164, a net loss of 1 point and Interborough Rapid Transit at 163¾, which is ¼-point off. Western Union closed at 94, a gain of 1½ points. Following are the closing quotations of December 20:

NEW YORK

	Dec. 13	Dec. 20		Dec. 13	Dec. 20
Allis-Chalmers Co.	15	16⅛	Electric Vehicle	16	16
Allis-Chalmers Co. pfd.	61	64	Electric Vehicle pfd.	23	21
American Tel. & Cable.	92	93	General Electric	183¾	185⅛
American Tel. & Tel.	143	146	Hudson River Tel.	..	..
American Dist. Tel.	..	..	Interborough Rap. Tran.	161	163⅜
Brooklyn Rapid Transit.	57⅞	60¾	Metropolitan St. Ry.	118¾	121⅛
Commercial Cable	..	..	N. Y. & N. J Tel.	..	..
Electric Boat	35	38	Marconi Tel.	..	..
Electric Boat pfd.	70	72	Western Union Tel.	92⅛	92¾
Electric Lead Reduction	⅛	⅛	Westinghouse com	178	182½
			Westinghouse pfd	190	190

BOSTON

	Dec. 13	Dec. 20		Dec. 13	Dec. 20
American Tel. & Tel.	144	146	Western Tel. & Tel. pfd.	*100	99
Cumberland Telephone.	122¼	120	Mexican Telephone.	1⅞	1⅞
Edison Elec. Illum.	250	253	New England Telephone.	137	136
General Electric	184	185	Mass. Elec. Ry.	14	14
Western Tel. & Tel.	21	*20	Mass. Elec. Ry. pfd.	61⅛	56⅛

PHILADELPHIA

	Dec. 13	Dec. 20		Dec. 13	Dec. 20
American Railways	48	48	Phila. Traction	98⅛	98⅝
Elec. Storage Battery	78	79	Phila. Electric	9⅝	10⅛
Elec. Storage Battery pfd.	78	79	Phila. Rapid Trans.	17¼	17⅜
Elec. Co. of America	10	10¼			

CHICAGO*

	Dec. 13	Dec. 20		Dec. 13	Dec. 20
Central Union Tel.	..	..	National Carbon pfd.	109½	110
Chicago Edison.	172	..	Metropolitan Elev. com.	23	22⅛
Chicago City Ry.	185	181	Union Traction	11⅛	9¾
Chicago Tel. Co.	..	145	Union Traction pfd.	40	38⅛
National Carbon	42¾	43			

* Asked.

DIVIDENDS.—The General Electric Company has declared a quarterly dividend of 2 per cent., payable January 14. The Otis Elevator Company has declared a quarterly dividend of 1½ per cent., payable January 14. The Western Union Company has declared the regular quarterly dividend of 1¼ per cent. The Strowger Automatic Telephone Exchange Company's directors have declared a semi-annual dividend of 50 cents, payable January 2. The Old Colony Street Railroad Company for the year ended September 30 paid dividends to the Massachusetts Electric Company of 3 per cent. and the Boston & Northern paid dividends of 2½ per cent. The Cumberland Telephone & Telegraph Company has declared its eighty-fifth quarterly dividend of 1¾ per cent., payable January 2. The directors of the Boston Suburban Electric Companies have declared a regular quarterly dividend of 50 cents a share on the preferred stock, payable January 15. The directors of the International Steam Pump Company have declared the regular quarterly dividend of ½ of 1 per cent. on the common stock, payable January 3. The Cincinnati Street Railway Company has declared the regular quarterly dividend of 1½ per cent., payable January 1. The Hestonville (Philadelphia) Passenger Railway directors have declared a dividend of $1.50 per share on the preferred and $1 on the common stock, payable December 20.

LIGHTING IN NORTHERN JERSEY.—Articles of incorporation have been filed with the Clerk of Hudson County at Jersey City by the North Jersey Electric Heat, Light and Power Company, the local office being at 15 Exchange Place. The capital stock is $500,000, of which $100,000 has been paid in. The incorporators are Benjamin F. Tracy, F. J. Smith and John O'Reagan. The local agent is John F. Tracy, who says that the object of the company is to furnish light, heat or power in any part of the State. He declined to say where the company will begin operations, or when. The company is said to be an offshoot of the American Lighting Company, of Baltimore. It is also said that it will compete with the Public Service Corporation. Mr. John C. Eisele, President of the New Brunswick Light, Heat and Power Company, of New Brunswick, has confirmed the report that that company would be leased to the Public Service Corporation.

LIGHTING AND TRACTION EARNINGS.—Messrs. Stone & Webster, of Boston, report the earnings of the following companies for the month of October, 1904:

	1904.	1903.	Inc.	Dec.
October gross	$12,008	$9,721	$2,287	.....
Net	5,088	4,321	766	.....
Surplus over charges	$4,322	$2,964	$1,358	.....
Jacksonville Electric Company:				
October gross	$29,358	$20,435	$8,923	.....
Net	9,402	5,333	4,068	.....
Surplus over charges	$6,384	$2,192	$4,192	.....
Lowell Electric Light Corporation:				
October gross	$21,723	$21,478	$245	.....
Net	10,661	8,851	1,809	.....
Surplus over charges	$9,538	$7,496	$2,041	.....
Savannah Electric Company:				
October gross	$48,171	$43,696	$4,474	.....
Net	21,357	17,432	3,924	.....
Surplus over charges	$10,663	$6,983	$3,679	.....
Houghton County Electric Lighting Company:				
October gross	$19,203	$16,305	$2,898	.....
Net	11,082	7,912	3,170	.....
Surplus over charges	$8,895	$5,724	$3,170	.....
Houghton Co. St. Ry. Company:				
October gross	$17,965	$15,452	$2,512	.....
Net	7,143	6,639	504	.....
Surplus over charges	$3,582	$4,515	.....	$933
Minneapolis General Electric Company:				
October gross	$58,984	$52,230	$6,754	.....
Net	28,447	24,359	4,088	.....
Surplus over charges	$19,180	$13,995	$5,184	.....
Tampa Electric Company:				
October gross	$32,708	$27,147	$5,560	.....
Net	13,624	11,524	2,100	.....
Surplus over charges	$11,739	$9,476	$2,262	.....
Terre Haute Traction & Lighting Company:				
October gross	$47,405	$44,409	$2,995	.....
Net	17,277	16,274	1,002	.....
Surplus over charges	$7,958	$7,874	$83	.....
Seattle Electric Company:				
October gross	$203,232	$186,501	$16,730	.....
Net	67,036	47,884	19,152	.....
Surplus over charges	$41,625	$24,978	$16,647	.....

CUMBERLAND TELEPHONE EARNINGS.—The earnings of the Cumberland Telephone & Telegraph Company show as follows:

	1904.	1903.	Changes.
November gross	$363,043	$314,563	Inc. $47,480
Expenses	209,581	177,987	Inc. 31,594
November net	$152,462	$136,576	Inc. $15,886
Charges	25,821	22,742	Inc. 3,079
November surplus	$126,641	$113,834	Inc. $12,807
Five months gross	1,707,691	1,487,576	Inc. 220,115
Expenses	1,028,486	862,247	Inc. 166,239
Five months net	$679,205	$625,329	Inc. $53,876
Charges	112,668	111,729	Inc. 939
Five months surplus	$566,537	$513,600	Inc. $53,937

SALE OF CHATTANOOGA PROPERTIES.—It is announced here that Isidore Newman & Sons, of New York, have purchased control of the Chattanooga Electric Railway, the Rapid Transit system and the General Electric Company, the three properties to be merged into one. Negotiations have been in progress for a year. At the office of Isidore Newman & Sons it is stated that while negotiations have been in progress to secure the Chattanooga properties, nothing definite has yet been done, but it is intimated that matters may reach a definite stage early next week. The firm are already interested in other electric properties in the South.

TELEPHONY IN IOWA.—Minneapolis capitalists, headed by S. S. Thorpe, have bought the Iowa properties of the Mississippi Valley Telephone Company for $400,000. Five exchanges covering the Iowa cities of Burlington, Muscatine, Keokuk, Madison and Wapello are taken over. New management will be elected and extensions will follow.

WESTERN UNION REPORT.—The Western Union Telegraph Company has issued a statement for the quarter ending December 31, 1904, which, compared with the corresponding period of two preceding years, is as follows:

	1904. (Estimated.)	1903. (Actual.)	1902. (Actual.)
Net revenue	$2,000,000	$2,000,000	$2,117,330
Bond interest	297,550	286,300	252,550
Balance	$1,702,450	$1,713,760	$1,864,780
Dividends	1,217,020	1,217,017	1,217,011
Surplus	$485,430	$496,743	$647,769

While the net revenue for 1904 as given in the above income account is estimated, sufficient returns are in hand to approximate the business closely, and for purposes of comparison, and as indicating the trend of the company's business, the report is sufficiently accurate. Combining the statement of the last quarter of the year with the previous quarter gives the comparative earnings for the half year as follows:

	1904. (Estimated.)	1903. (Actual.)	1902. (Actual.)
Net revenue	$7,887,474	$8,214,472	$7,292,328
Bond interest	1,157,700	1,077,700	992,580
Balance	$3,472,905	$3,774,656	$3,859,404
Dividends	2,434,040	2,434,034	2,434,021
Surplus	$1,038,865	$1,340,622	$1,425,383

The 1904 earnings are less than the two preceding years, but are in excess of 1901, in which year the net revenue for the half year was $3,807,634. The income account condensed for the fiscal year ending June 30, 1904, compared with the two preceding years, is as follows:

	1904. (Estimated.)	1903. (Actual.)	1902. (Actual.)
Net revenue	$7,887,447	$8,214,472	$7,292,328
Bond interest	1,157,700	1.077,700	992,580
Balance	$6,729,774	$7,136,772	$6,299,748
Dividends	4,868,070	4,868,050	4,868,031
Surplus	$1,861,704	$2,268,722	$1,431,717

The fiscal year to June, 1905, will show a decrease from the preceding year if the next six months show the same proportionate business as the last.

MASSACHUSETTS ELECTRIC.—In their report to the stockholders of the trust securities of the Massachusetts Electric Companies, the trustees preface the statement of decreased earnings with the declaration that the weather conditions during the past year have been "the most trying and unsatisfactory known since street railways have played any considerable part in the transportation of the public." This, so far as it affected the operation of the lines controlled by the Massachusetts Electric Companies, is undoubtedly true, the gross expenses from January 1 to May 1 being $250,000 above the normal, and the gross receipts for the three months falling $110,000 below those of the corresponding period for 1903. The company, however, has continued to pay its regular dividends, with a deficit for the year amounting to some $27,000, and has reduced its surplus to a narrow $29,000. The Massachusetts Electric Companies control, through ownership, 790 miles of road, and through lease sixty-two miles. The property is worth about $35,500,000. The capital stock is $16,760,000 issued, and the funded debt is now about the same amount. Earnings in 1904 were $6,380,803 gross and $1,901,342 net, with charges of $1,462,626.

THE EVERETT-MOORE SYNDICATE.—The Everett-Moore syndicate has recently made arrangements which will go a long way toward clearing up its indebtedness, and if other negotiations in regard to its telephone properties can be put through it is expected that the syndicate will be able to adjust all its obligations. The recent sales of $8,200,000 of Detroit United Railway bonds removed further care from syndicate in the matter of the Detroit United. The Citizens Savings & Trust Company, of Cleveland, has closed an option at 62½ for Northern Ohio Traction & Light bonds of a par value of $578,000, which includes all the Everett-Moore holdings in this issue. There has been a general advance in Everett-Moore securities recently, and other sales have been made which have brought the syndicate considerable money. A year ago the bankers' committee secured from the creditors an extension to April 1, 1905. The statement is made that the obligations which a year ago amounted to $4,500,000 have been reduced to less than $1,500,000.

DETROIT TROLLEY BONDS.—An issue of $8,200,000 Detroit United Railway first consolidated mortgage 4½ per cent. thirty-year gold bonds is offered to investors by Kean, Van Cortlandt & Co., of New York, at 94½ per cent. and accrued interest. The Detroit United owns and operates 533 miles of track, constituting practically the entire street railway system of Detroit. The total issue of these bonds is $25,000,000, of which only $10,700,000 are outstanding, including the amount now offered.

WINNIPEG TROLLEY BONDS.—N. W. Harris & Co. and the Bank of Montreal announce that the $2,000,000 Winnipeg Electric Railway Company 5 per cent. bonds offered by them have all been sold and that the issue was largely over subscribed.

Commercial Intelligence.

THE WEEK IN TRADE.—Manufacturing activity increases steadily and the conditions, as regards trade, crops and industries, are mainly favorable. Holiday goods sell more freely than staples, but all classes of merchandise are going into larger consumption, while it is the exception when there is complaint regarding mercantile collections. The proportion of idle machinery is growing smaller and the number of unemployed hands less, few labor disputes of significant dimensions existing outside of Fall River. Iron and steel plants are gaining steadily; footwear forwardings are running close to the large figures of last year, and irregular raw materials supply the only serious element of uncertainty in the textile industries. Farm staples are returning large profits to producers, and foreign trade returns for November showed a very small loss in exports, considering the abnormal figures last year. The iron and steel industry has gone steadily forward, prices rising 50 cents a ton further for pig iron, making the current level about $2.50 per ton higher than prevailing quotations a year ago. The price of rails has been fixed at $28, this action being preceded and followed by liberal buying by railroads, which, however, have not confined their takings to rails, but have taken liberally of structural material for bridges and of general supplies. Sales of rails to Southern roads are reported to aggregate 125,000 tons. Chicago reports sales of 100,000 more, and the Pennsylvania Railroad has bought about the same amount, making the sales of the past ten days approximate 325,000 tons. Outside of the railway branch the trade displays great cheerfulness. There is no evidence of inflation in the present situation, fuel shortage increasing the cost of production, while orders covering all the product of some furnaces for the first quarter of next year testify to the faith of consumers. This forward business is the best feature of the market, buyers having confined their contracts to immediate requirements during the recent period of stagnation. Railway earnings for November show gains in gross exceeding 9 per cent., following an increase of 4 per cent. in 1903, and rendering certain the prospect that the early small decrease shown in gross receipts for the calendar year will be turned into an increase. The business failures for the week ending December 15, as reported by *Bradstreet's*, aggregated 239, against 231 the previous week, and 239 the corresponding week last year. Copper prices remain firm, at 15c. for Lake; 14⅞ for electrolytic, and 15⅝ for casting stock.

A NICARAGUAN DEAL.—The United Fruit Company interests of Boston are reported to be largely concerned in the Central American Commercial Company, which has just been organized with a capital of $1,000,000, to effect a merger of the business of T. M. Solomon & Co., the Corinto Wharf and Agency Company, the Nicaragua Electric Company, the Campuzano Plantation, Nicaragua. The Solomon firm is the financial and purchasing agent for La Nicaragua in the United States and Europe. The Corinto Wharf and Agency Company holds a concession from the Nicaragua government, permitting of the building and operating of a wharf at the port of Corinto, which is the only protected harbor on the Pacific coast of Nicaragua. The concession is for fifty years. The company is exempt from all taxation and has the right of transportation over the government railroads at one-half the usual freight rates during the life of the concession. All merchandise, etc., imported and exported must pass over the wharf, and the company is guaranteed a tariff of $1.60 gold for every ton handled. The Nicaragua Electric Company holds a 50-year concession to light the city of Managua (population about 30,000), the capital of the republic. It will considerably increase its capacity.

EQUIPMENT FOR PEARLINE PLANT.—James Pyle & Sons, manufacturers of Pearline, 436 Greenwich Street, are to build a large electrically operated plant at Edgewater, N. J. The initial installation will consist of about 400 hp. of equipment and 35 motors of various sizes. Mr. William S. Pyle, of the firm, has the matter in hand. Lockwood, Green & Company, of 93 Federal Street, Boston, are the consulting engineers.

EQUIPMENT FOR CONVERSE PLANT.—The equipment to be installed in the power plant which Mr. Edmund C. Converse, of 139 Broadway, will build on his Greenwich, Conn., property will consist of a 100 kw. generating unit and about 60 hp. of motors. Mr. James Robert Moore, of 156 Fifth Avenue, is the engineer.

ELECTRIC GRAIN ELEVATOR.—Van Zandt & Voorhees, of Plainfield, N. J., are to build a large grain elevator which will be electrically operated.

ELECTRICAL IRON SMELTING.—A Canadian correspondent of the *Iron Age* says: "The report which the Dominion Government's Commission brought back from Europe on the subject of electrical smelting has not been allowed to drop out of sight. Interest in it is kept alive by remarks upon it that appear from time to time in newspapers, some of them discussing the applicability of the method to local ore deposits. How it would work in practice remains to be seen. There is a possibility that a commercial test of it may be made at one of the power centres in the neighborhood of Peterborough, Ont., one of the most enterprising of Canadian manufacturing towns. O. E. Brown, the electrical expert who accompanied the commission to Europe, has recently received a report as to the character of the ore that Peterborough works would be likely to utilize. The ore in question is that of the Belmont mine. The report referred to was prepared by a Toronto man, who had subjected specimens of the ore to a process of magnetic separation. It is stated that the yield of iron from the specimens was from 70 to 71 per cent. Mr. Brown appears to think that iron can be produced in the Peterborough locality at a cost below the $10 limit named in the commission's general report. That limit was based on calculations which allowed $10 per horse-power per annum for the electricity and $7 per ton for coke, and assumed the iron to average 55 per cent. It is estimated that the cost of producing power at Heeley's Falls, near Peterborough, will not exceed $6 per horse-power per annum, and charcoal at $4 a ton is considered to be a possible equivalent for coke at $7, while ore grading above 55 per cent. is expected from the Belmont mine. According to a rough estimate made by Mr. Brown a power plant and electric smelter of 100 tons daily capacity can be constructed and equipped for about $750,000. Of this amount the greater part would be required for the power plant, the smelting apparatus costing comparatively little. Very great interest in the project is shown by the Peterborough people." Peterborough is the manufacturing headquarters of the Canadian General Electric Company.

OUR FOREIGN COMMERCE.—The total foreign commerce of the United States in the year about ending seems likely to exceed that of any preceding year. The total exports will probably fall slightly below those of last year and of the years 1900 and 1901, but as the total imports will materially exceed those of any preceding calendar year, the grand total of imports and exports combined will probably be the largest in the history of our commerce. The statement of the November commerce and of the eleven months ending with November, just issued by the Department of Commerce and Labor, through its Bureau of Statistics, shows imports for the eleven months ending with November, 1904, amounting to $939,000,000, against $918,000,000 in the corresponding months of 1903, $875,000,000 in the corresponding period of 1902, $800,000,000 in the corresponding period of 1901, and $760,000,000 in the corresponding period of 1900. Thus the imports for the full year seem likely to exceed those of any preceding calendar year, and for the first time in the history of calendar years imports will exceed $1,000,000,000 in value. The total value of merchandise imported in the calendar year 1903 was $995,000,000 dollars; in 1902, $969,000,000; in 1901 $880,000,000; in 1900, $829,000,000; in 1899, $799,000,000, and in 1898, $635,000,000. While the import record seems likely to exceed that of any earlier calendar year, the total of exports for the eleven months ending with November, 1904, is about $5,000,000 below the figures for the corresponding months of 1903, and $23,000,000 below those of the corresponding period of 1901. This slight reduction in exports is, of course, due to the great falling off in exports of breadstuffs, which amounted in the eleven months ending with November, 1904, to only $82,000,000, against $176,000,000 in the corresponding months of 1903, and $252,000,000 in the corresponding months of 1901.

AUTOMOBILE SIMPLIFICATION.—A committee, representing the superintendents and engineers of twenty-five of the leading automobile factories of the country, met recently at the Engineers' Club, to discuss a permanent organization of the mechanical heads of the various manufacturing plants, that the perfection of the American automobile might be hastened. The project of organization is to be carried out. In deciding to organize, the committee agreed that the objects of the association should be the exchange of ideas in construction and a study of the methods by which the automobile best may be simplified, through reducing the number of parts, making them of standard measure and arranging them in the most accessible manner, at the same time lowering the cost of production. A meeting of the whole body of engineers and superintendents has been called for January 19, in this city, at the time of the Automobile Show, to complete organization. The new association will be known as the superintendents and engineers' branch of the Association of Licensed Automobile Manufacturers. When formed, the branch will deal entirely with constructional questions, and act in an advisory capacity to the manufacturers.

GAS ENGINE PLANT AT SAUGATUCK, MICH.—A thirty years' franchise for electric lights and gas has been granted by the village of Saugatuck, Mich., containing about 1,500 population, but which has in addition several hundred resort cottages to whom light will be furnished. The government is spending close to $250,000 in improving the harbor at Saugatuck, and when its work has been completed, this will be one of the best ports on the east shore of Lake Michigan. The franchise was given to Charles A. Floyd, of Holland, purchasing agent and general passenger and freight agent for the Grand Rapids, Holland and Chicago Railway, and will be transferred by him to a company to be known as the Saugatuck Lighting and Power Company, with general offices at Holland, Mich. This company will put in a plant operated by gas engines. An alternating system will be used.

NEW TELEPHONE FACTORY.—Mr. J. G. Thursen, general manager of the American Electric Telephone Company, of Chicago, informs us that they have awarded the contract for their new factory building at Sixty-fourth and State Streets, Chicago, and will be able to occupy it about April 1, 1905, as the excavating and foundation work has all been completed. The ground value is about $65,000, and the building will cost something over $100,000. It will be a complete brick factory building, saw-tooth roof construction, with a two-story office and frontage of 300 feet on State Street. The plans were drawn by Architects Nimmens and Fellows, and the general contract work is being done by Jacob Rhodatz. The building will contain about 75,000 square feet of floor space, exclusive of the power plant, warehouse and wood-working factory.

LOS ANGELES-KERN RIVER PLANT.—With the beginning of the year work will be actively pushed on the Kern River generating plant of the Edison Electric Company, of Los Angeles, at which time 400 men will be added to the present force working there. Contracts have not been let for the generators, which will have a total capacity of 25,000 kw. The power will be transmitted to Los Angeles, 120 miles distant, at 66,000 volts, the conductors to be supported on steel towers 75 feet high and 600 feet apart.

THE NORTHERN ELECTRICAL MFG. CO., Madison, Wis., recently received an order for three 150-kw. slow speed generators from the Tennessee Coal Iron & Railroad Co., of Birmingham, Ala. The order was received through J. B. McClary & Co., representing the Northern Electrical Mfg. Co. at Birmingham. The Tennessee Coal, Iron & Railroad Co. is the largest of its kind in the south, and the order was secured even though the prices on Northern machinery were met by competing manufacturers.

HEINE BOILERS FOR LYONS PLANT.—The Heine Safety Boiler Co., Bowling Green Building, has secured the contract for the boilers with superheaters to be installed in the Lyons, N. Y., plant of the Rochester & Eastern Railroad which is being built by the Syracuse Railway Construction Co., of which Mr. C. D. Beebe is president and general manager. There will be 2100 hp. installed in six units of 350 hp. capacity each. The superheaters will also be of Heine build.

EQUIPMENT FOR PORTOZUELO HYDRAULIC PLANT.—The Portozuelo Electric Power Company, of Puebla, Mexico, is about to be equipped with a 1500 hp. Pelton water wheel arranged for direct connection to a 1000 kw. General Electric generator. The Pelton Water Wheel Company has also secured the contract for the pipe line.

ELECTRICITY FOR OHIO ROLLING MILL.—A large electrically operated rolling mill is to be built at the La Belle Iron Works, Steubenville, O. The United Engineering & Foundry Co., of Pittsburgh, Pa., has secured the contract for the mill. Electric traveling cranes will also be installed in the plant.

LIGHTING PLANT FOR DESPATCH, N. Y.—An electric lighting plant is to be built at Despatch, N. Y. It will entail an expenditure of some $400,000. Philadelphia and Rochester men are chiefly interested in the enterprise. Mr. Henry Ives Cobb, of 115 Broadway, is the architect chosen.

EQUIPMENT FOR FACTORY.—An isolated plant of fair-sized proportions will be installed in the Fred. Gretsch musical instrument factory at South Fourth Street, Brooklyn. Mr. Percival Robert Moses, 35 Nassau Street, has been appointed the engineer for the work.

PLANT FOR APARTMENT HOTEL.—The Long Acre Realty Company, of which Mr. E. Clifford Potter, of 135 Broadway, is president, is to build a large apartment hotel at 71-75 West Forty-fifth Street, which will have a good-sized lighting plant.

NEW POLICE HEADQUARTERS PLANT.—Clark & MacMullen, of 20 Broad Street, are the electrical engineers for the new Police Headquarters to be constructed at Centre and Broome Streets.

PLANT FOR MAIDEN LANE BUILDING.—Mr. Albert Lorsch, the diamond merchant, is to build a large office building at 37 Maiden Lane which will have an isolated lighting plant.

UNITED BOX BOARD PLANS.—The plan to utilize electrical power to operate the Lockport, N. Y., plants of the United Box Board & Paper Company has been abandoned.

General News.

THE TELEPHONE.

HUNTSVILLE, ALA.—Another co-operative telephone company is being formed by Madison County farmers and the proposed system is planned to connect Wooley Springs, Jeff, Cluttsville and other communities in the northwestern part of the county with the Huntsville exchange.

HUNTSVILLE, ALA.—The Southern Bell Telephone Company is making arrangements to install a new common battery system in Huntsville at a cost of about $25,000. The company made an agreement with the City Council to make this improvement, provided no other company is granted a franchise within a certain time, and it is agreed that the new system be ready for operation by April 1, 1905.

HOT SPRINGS, ARK.—A municipal telephone station system will probably be installed in this city. The matter is now being considered by the Mayor and Council, and convenient stations for boxes picked out, which will connect headquarters with all parts of the city by telephone. The new equipment will be installed by January 1.

REDONDO, CAL.—At a meeting of the Board of Trustees, the application for a 50-year telephone franchise was sold to the Home Telephone Company.

SANTA MONICA, CAL.—Notice has been given by City Clerk J. G. Hemingway that sealed bids in writing will be received up to 8 p. m., January 3, 1905, for the purchase of a telephone and telegraph franchise to operate in the City of Santa Monica.

SAN LUIS OBISPO, CAL.—S. D. Ballou has applied to the supervisors for a franchise to construct and maintain a telephone system along public roads of San Louis Obispo County. Bids for said franchise will be received up to 10 a. m., January 3.

CRIPPLE CREEK, COL.—The Colorado Telephone Company will spend approximately $50,000 in the Cripple Creek district, commencing shortly after the new year, in making improvements and installing practically a new telephone system.

MONROE, GA.—At a meeting of the Monroe Telephone Exchange Company, the Walton Telephone & Telegraph Company, and the Monroe & Crompton Telephone & Telegraph Company, held recently, a consolidation of all the companies resulted. Beginning January 1, the combination will be styled the Monroe Telephone Company.

CLARKSBURG, ILL.—A telephone line is being built into the city by Mr. J. Clanson.

FREEPORT, ILL.—The Badger State Telephone Company has purchased the Crosby & Blaisdell Telephone Company and took possession December 1.

BELLEVILLE, ILL.—The Rural Telephone Company has been incorporated by Albert Hucke, Lucius D. Turner and George W. Detharding. The capital of the new company is $2500.

ALEXIS, ILL.—The Farmers' Mutual Telephone Exchange Company has been formed; capital, $5000, to operate telephone systems. Incorporators: Allen Moore, Warren Bruington and R. T. Shaw.

ALTON, ILL.—Improvements in the telephone systems in Alton, the cost aggregating $80,000, are in progress. The Central Union Company is installing a new switchboard, besides automatic telephones. The Kinloch Company is installing a cable service.

ROCKFORD, ILL.—The rural telephones in Boone County which have been operated by the Central Union Company, are to be taken over by a company organized under the name of the Boone County Telephone Company. People prominently interested in the Winnebago County Telephone Company are interested in the Boone County Company.

BELLEVILLE, ILL.—The Rural Telephone & Telegram Company has filed papers of incorporation. The company will start business with a capital stock of $2500. The incorporators are L. D. Turner, Albert Hucke and Geo. W. Detharding, of Belleville. The rural telephone system will be connected with the central office of the Bell Telephone Company in Belleville.

JERSEYVILLE, ILL.—The Kinloch Long Distance Telephone Company has made connection at Jerseyville with the Illinois Telephone Company's lines, forming through service from St. Louis to all the principal cities in Illinois. The Kinloch people also secured a lease on the Wagner building, where a central office will be established. E. H. Dennison, of St. Louis, who is pushing the extension of the Kinloch lines in Illinois, had a conference at Jerseyville a few days ago with Stephen MacDonald, of the Calhoun County Telephone Company and an agreement was entered into for the transmission of Kinloch messages to Calhoun County points by the way of Grafton, Jersey County. The Bell Company will maintain its service in the county through the Jerseyville office by direct connection at Hardin.

SOUTH BEND, IND.—The South Bend Home Telephone Company has authorized a number of extensions of its lines in this city.

RUSHV$IIE, IND.—J. F. Butterfield & Company, of Chicago, have just completed extensive improvements for the Rushville Co-operative Telephone plant. Some 15,000 feet of cable was installed at a cost of nearly $7500.

SALEM, IND.—The Blue River Valley Telephone Company has incorporated with a capital stock of $12,000. John H. Tallock, Chas. A. Martin, E. G. Philips, J. E. Brewner and Arthur Purlee are the incorporators.

LEBANON, IND.—The City Council has granted a 20-year franchise to the Central Union Telephone Company to operate a local exchange in this city, The Mayor is asked to veto the ordinance, and if the franchise is passed over his veto it is insisted that the price be fixed so that no greater amount shall be charged than at present by the local telephone company.

FORT WAYNE, IND.—The annual meeting of the stockholders of the Home Telephone Company was held last week and the following-named officers were elected: President, Charles Bash; secretary, Wm. L. Moellering; treasurer, Max B. Fisher. The secretary's report showed a total of 3220 telephones in operation, with a growth of fifty per month on the average. The South Side exchange now has 800 connections.

GREENFIELD, IND.—A bitter rivalry exists between the Greenfield Independent Telephone Company and the Central Union Company. Difficulty has been experienced in calling out the volunteer fire department, owing to the fact that members of the department have installed different telephones. Mayor Carr has notified the engineer at the city pumping station to pay no attention to an alarm turned in over the Central Union. This order is very generally criticised and the Council has taken the matter up for adjustment.

ALTA, IA.—At a special election here, the Alta Telephone Company was granted a 20-year franchise.

KEOKUK, IA.—The Bell Telephone Exchange was destroyed by fire, caused by an overheated furnace.

TRIPOLI, IA.—The telephone line from this place to Waverly, via Plainfield and Horton, has been purchased by the farmers on that line.

DUNCOMBE, IA.—The Duncombe Telephone Company has purchased the north end of the Lehigh line, which it is now connecting with the local system.

DUNKERTON, IA.—The Blakesville Farmers' National Telephone Company has been incorporated with a capital stock of $5000. The officers of the company are: President, C. W. Smith; vice-president, Martin Rinderknecht; secretary, William Rodger; treasurer, Sidney Weick.

OTTUMWA, IA.—Messrs. S. W. Crosby, of Ashtabula, Ohio, and H. W. Stecher, of Cleveland, have been in Ottumwa, closing up the business of the Ottumwa Telephone Company, and making the transfer of the title to all the property previously held by that company, to the Ottumwa Telephone & Electric Company. These gentlemen represent the creditors of the old company who bought it in when it was recently sold. The business has been reorganized and will henceforth be known as the Ottumwa Telephone & Electric Company, of which Mr. Crosby is the president and Mr. Stecher the secretary.

GALESBURG, ILL.—A movement is on foot looking toward a connecting union between the Galesburg Union Telephone Company and the telephone lines of Canton and Lewistown, so that free interchange can be arranged.

WICHITA, KAN.—In the case of the City of Wichita against the Missouri & Kansas Telephone Company the State Supreme Court has decided in favor of the telephone company. This decision finally settles the fact that the Missouri & Kansas Telephone Company has a right to construct and operate telephone lines in Wichita.

LEXINGTON, KY.—Geo. C. Webb has been selected as receiver for the the construction of a telephone line to Madison. The claimholders have been notified to file their claims as soon as possible in order that the receiver may wind up the affairs of the company.

CUMBERLAND, MD.—Representatives of the independent long-distance concerns in Western Pennsylvania, West Virginia and Maryland at a meeting held in Cumberland, voted unanimously to join the Eastern Traffic Association of independent telephone companies.

BALTIMORE, MD.—The Chesapeake & Potomac Telephone Company has recently made important additions to its service in Carroll County. The line from Westminster to Manchester has been extended to Alesia and Lineboro. In the western part of Carroll County new lines have been built from Union Bridge to Middleburg, Bruceville and Double Pipe Creek. The company has also been enlarging its plant in the southern part of Carroll County. Among the points covered by this addition are Morgan and Woodbine, in Carroll County, and Lisbon and Poplar Springs, across the line into Baltimore County. The company has further been building new lines in Harford County, and is now completing a line to Taylor and to High Point, in Harford County. A new line to Chaneys and Dunkirk has also been put in service.

HART, MICH.—The Lake Shore Telephone Company, with headquarters in this town, has installed an automatic system at Pentwater.

HENRIETTA, MICH.—The Henrietta Central Telephone Company has been incorporated, capital $550. T. J. Spears, Jerry Truner and Allie White are directors.

ST. PETER, MINN.—Stockholders of the Nicollet County Telephone & Telegraph Company are considering purchasing the St. Peter telephone system and increasing the capital stock of the company.

MEDFORD, MINN.—The Straight River Telephone Company has been organized at Medford, and will construct a telephone line between that village and Owatonna. The officers are: President, B. Benham; secretary, W. F. Eaton; treasurer, Joe Taylor.

CENTRALIA, MO.—The Centralia Telephone Company has increased its capital stock from $6000 to $30,000.

LINCOLN, NEB.—The Western Telephone Company has completed stringing its copper wires into Palmyra, where connection is made with the Nebraska City Company's lines.

HASTINGS, NEB.—The Trumbull Exchange became a part of the Hamilton County Farmers' Telephone Association on December 1. The line was inspected and accepted by the officials.

ASHLAND, NEB.—The Ashland Telephone Company has been re-organized, the changes in the directory to take place January 1. H. H. Herndon, who owned a controlling interest, has sold his stock to H. A. and E. A. Wiggenhorn, Jr., and C. F. Folsom.

SPARKS, NEV.—The Sunset Telephone Company has established an office in this city.

GREENSBORO, N. C.—The Southern Bell Telephone Company has awarded the contract for a handsome three-story exchange and office building at Greensboro, to cost about $15,000.

STATESVILLE, N. C.—The Board of Aldermen of Statesville has just refused a franchise to the Bell Telephone Company, which desired to enter the local field and buy the local exchange.

GRAND FORKS, N. D.—At a meeting of the Bonner Telephone Company held in this city the present officers, Ole Bang, president, and James Elkington, secretary and treasurer, were re-elected. The company operates the rural line between this city and Grantville and his 34 miles of wire.

RINARDS, OHIO.—The Pryor-Bode Telephone Company, capital $5000, has been formed. Incorporators are J. W. Pryor, Martin Bever, C. E. Bode and J. F. English.

PORTLAND, ORE.—An ordinance has been introduced into the Council and referred to the judiciary committee with the end in view of repealing the franchise of the Pacific States Telephone & Telegraph Company, the Bell organization. It is claimed that the service given by the company has been very unsatisfactory, and that there is a great opening for a live independent concern.

WAYNESBORO, PA.—Officials of the Pennsylvania Telephone Company contemplate extending a line from Waynesboro to Quincy and Mont Alto. The company's engineers have gone over the route, also over the route to White Mills, with a view to running a loop to that point.

PITTSBURG, PA.—All the important difficulties in securing rights of way for the new Pittsburg & Allegheny telephone line to Wheeling, in connection with the national telephone system, have been settled satisfactorily and the line has been completed from Wheeling to Bridgeville.

NEW ALBANY, PA.—The New Albany Telephone Company will contruct a telephone line from New Era, in Bradford County, to Evergreen and New Albany, and also from Overton to Campbellsville, Eldredsville, Estella and Forksville. The principal directors of the company are R. S. Wilcox, R. Decker and S. D. Sterigere.

BEAUFORT, S. C.—There is some talk of extending the lines of the Bell Telephone Company about Beaufort to reach many farmers in the suburbs.

ANDERSON, S. C.—After a long fight a franchise has been granted a telephone company at Anderson, allowing, among other privileges, the charging of tolls to outside points in the surrounding country.

GEDDES, S. D.—The Town Council has passed an ordinance allowing the Dakota Central Telephone Company to build a line into town.

PIERRE, S. D.—A telephone line 40 miles long has been completed from Leslie, on the Cheyenne River, for the accommodation of ranchers on the Cheyenne Reservation. Most of the line is simply wire fence, which is used on the boundary lines of the reservation pastures, and the system is to be extended in the same way. The line now in operation is all on the Indian Reservation, but a general system, with Leslie as a central point, is being planned to cover a large part of that portion of the State.

MADISONVILLE, TEX.—The Madisonville Telephone Exchange has been purchased by Messrs. A. B. Foster and H. D. Hunter, who are now owners of the local exchange and all franchises connected therewith. Mr. Foster is manager of the Huntsville exchange and is interested in several other telephone companies. It is understood that extensive improvements are contemplated.

OGDEN, UTAH.—A new switchboard, which will cost approximately $35,000, will be installed here in the near future by the Rocky Mountain Bell Telephone Company.

LYNCHBURG, VA.—The Southern Bell Company has purchased the franchise and equipment of the local telephone company.

FAIRWATER, WIS.—The Green Lake Telephone Company has recently been organized at Fairwater.

RACINE, WIS.—The Citizens' Telephone Company is making improvements to its exchange. A new station may be erected and an automatic switchboard put in.

DELAVAN, WIS.—At a recent meeting of the business men of Delavan, it was decided to stand by the Walworth County Telephone Company. The Bell Company is making an effort to get the Delavan business, and as an inducement is said to be putting in telephones free.

MILWAUKEE, WIS.—President Alonzo Burt, of the Wisconsin Telephone Company, states that as soon as the frost is out of the ground in the spring the company will begin building operations on its eight-story office building on the west side of Fifth Street, just north of Grand Avenue. The new building will cost between $150,000 and $200,000, and the equipment will cost an additional $150,000.

ST. JOHN, N. B.—There are now three telephone companies in the Province of New Brunswick, and all are extending their lines. The oldest, the New Brunswick Telephone Company, is spreading out in the up-river counties, where the Union Company, with headquarters at Florenceville, is doing the same. The Central Company has its headquarters at Bellisle, in Kings County, and there is a rumor of an amalgamation of the Union and Central. If this occurs there will be two strong rival companies in the province. The St. John City Council has approved a proposition either to install a system of its own or negotiate with another company to enter this field and compete with the New Brunswick Company, whose rates have been increased and are declared to be excessive.

KINGSTON, ONT.—The members of the finance committee of the City Council of Kingston, after six months' negotiations with suggested telephone companies, have come back to the Bell Telephone Company, and the Council has endorsed an agreement for an exclusive franchise to the company for five years. The city is to receive $700 per year; free use of poles for fire alarm wires; telephones to citizens at $30 for business telephones and $25 for residence telephones; two party lines for residences at $18 each, and four at $15 each. The company also agrees to erect a fine office building and install metallic lines with latest improved instruments.

ELECTRIC LIGHT AND POWER.

POCAHONTAS, ARK.—The Pocahontas Power Company proposes to construct an electric light plant, to cost $25,000. Ruebel & Wells, St. Louis, Mo., are the engineers.

BATESVILLE, ARK.—The Batesville Power Company has been incorporated, with a capital of $10,000, by F. P. Albright, A. R. Weaver and Wm. Ramsey, to develop water and steam power for electrical, commercial and manufacturing purposes.

NEEDLES, CAL.—The Murphy Water, Ice & Light Company will construct an independent electric light plant to be used for lighting the city.

CALISTOGA, CAL.—Bids will be received Jan. 3 by Frank Teale, Town Clerk, for a franchise to construct and operate an electric light and power system here.

SAN FRANCISCO, CAL.—E. J. de Sabla, Jr., and John Martin, officials of the California Gas & Electric Corporation, which furnishes electric power for the operation of many gold dredges, are interested in the recent purchase of 1200 acres of valuable dredging land along the Yuba River near Marysville, Cal. It is understood that the purchasers are about to incorporate a dredging company with a capital stock of $1,000,000 subscribed by Eastern and San Francisco capitalists. Two large gold dredges have been contracted for and it is the intention to order seven more.

GOLDFIELD, COL.—Rodney Curtis, of the Denver Tramway Company, Denver, is interested in the construction of an electric plant on Bishop Creek to supply Tonopah and Goldfield with electricity.

DALLAS, GA.—The Dallas Light & Power Company has been formed with a capital of $5000. A. J. Cooper is president and E. H. Robertson, secretary.

GREENSBORO, GA.—Bids will be received Dec. 20 by the Mayor and Aldermen for $5000 municipal bonds to be used for installing an electric light plant in this city. Jas. H. McWhorter is City Clerk.

CAYUGA, ILL.—The City Council is investigating the cost of constructing an electric light plant.

BELLEVILLE, ILL.—The Ada Electric & Gas Company has been incorporated with a capital stock of $100,000 for furnishing light, heat and power and manufacturing ice. The incorporators are J. A. Hamilton, A. B. Daab and L. D. Turner, Jr.

MACKINAW, ILL.—The Mackinaw Electric Light Company has been incorporated with a capital of $8000. The new company, the incorporators of which are S. A. Thompson, George Tyrell and C. G. Sparks, will furnish light, heat, water and power.

EDWARDSVILLE, ILL.—At the annual stockholders' meeting of the Edwardsville Electric Light & Power Company, Frederick Gut, of St. Louis, was elected to the directorate to succeed Ole Peterson. The latter's stock was purchased by David Davis, of Litchfield. The other directors were re-elected. The annual report showed that the company had built 8.35 miles of new line during the year.

LEBANON, IND.—A franchise for an electric light plant has been granted to the Citizens' Electric Light & Ice Company.

DUNKIRK, IND.—The Dunkirk Lighting Company has incorporated, capitalized at $21,000. Jesse M. Soper, C. H. Harkins and C. O. Reynolds, all of Chicago, Ill., are the incorporators.

MATTHEWS, IND.—The Matthews Electric Light & Power Company has filed articles of incorporation with the Secretary of State. The initial capital is $15,000. Plans are now being made for the erection of a plant in this city. Philip Hughes, E. W. Trook and G. S. Reniholt are directors.

EVANSVILLE, IND.—The Evansville Gas & Electric Light Company, of Evansville, has secured the contract for lighting the city for five years with electric arc lights of 2000 candle power at $67 per lamp per year. F. T. Hunting, of Fort Wayne, bid for electric arc lights $73 per lamp per year.

MONTICELLO, IND.—Civil engineers are making a survey of the Tippecanoe River for the purpose of locating and building three dams, to utilize the water power in the generation of electricity for this city, and for the operation of an interurban railway to pass through this section of the country.

CLARINDA, IA.—The Lee Electric Light Company, of Clarinda, has been incorporated; capital $50,000. J. Ren Lee is one of the incorporators.

FORT FAIRFIELD, ME.—The Fort Fairfield Electrical Company has been organized to furnish gas and electricity in Fort Fairfield, with $40,000 capital stock. Harry L. Cram and A. J. Desmond, both of Portland, are the incorporators.

ARLINGTON, MASS.—At the annual town meeting the municipal ownership proposition as regards the lighting plant was rejected.

HOLYOKE, MASS.—W. H. Snow, manager of the Gas and Electric Light Department, has asked for bids for new engines, boilers, generators and other improvements at the electric light plant.

BERRIEN SPRINGS, MICH.—J. Du Shane, of South Bend, Ind., writes that it is proposed to construct a power dam at Berrien Springs, but that nothing will be done this season.

BAGLEY, MINN.—Bids will be received Jan. 3 by the Village Council for $13,000 in bonds for the purpose of purchasing the electric light plant and constructing a water works system. Oscar Barness is village recorder.

GREY EAGLE, MINN.—Guy Robbins has secured a franchise for an electric light plant.

MINNEAPOLIS, MINN.—An ordinance has been introduced in Council to grant a 30-year franchise to the Minnesota Power & Trolley Company, of Champlin, Minn., to erect poles and string wires for the purpose of transmitting electricity to this city.

ST. LOUIS, MO.—A building permit has been granted to the Union Electric Light & Power Company for the erection of a sub-station to cost $26,000.

DONIPHAN, MO.—The Doniphan Ice, Light & Manufacturing Company has been incorporated with a capital stock of $25,000. The incorporators are F. Moech, F. D. Hartel and C. M. Wheelock.

GRANT CITY, MO.—The Grant City Electric Light & Manufacturing Company has been incorporated with a capital stock of $15,000, all paid. The incorporators are G. A. Haynie, L. N. Fry, A. Goodsell, B. C. McMahan and C. S. Hotaling.

JOPLIN, MO.—The Spring River Power Company, of Kansas, has filed articles of incorporation to show that it had been incorporated under the laws of the State of Missouri, with a capital of $450,000, of which $50,000 is to be employed in Missouri, with an office in Joplin.

GRENADA, MISS.—The Town Council is taking steps to enlarge the electric light plant.

HATTIESBURG, MISS.—The City Council has granted G. L. Hawkins and associates a franchise to operate an electric light plant in Hattiesburg. The franchise includes the right for a street railway system.

BRIDGETON, N. J.—The contraction for lighting the city for a period of five years has been awarded to the Bridgeton Electric Company.

PERTH AMBOY, N. J.—The Public Service Corporation has secured the contract for lighting the city for five years at $97.50 per lamp per year.

NEWARK, N. J.—The Middlesex Lighting Company, of Newark, has been incorporated; capital, $100,000. Incorporators: Albert B. Carlton, Elizabeth; Percy S. Young, Passaic, and Fred'k Evans, New York City.

TRENTON, N. J.—The Council has adopted a resolution providing for the appointment of a committee with power to investigate the advisability of constructing an electric light plant. President Thomas appointed Samuel W. Throp as one of the committee.

IRVINGTON, N. J.—The United Electric Company has secured the contract for lighting the city for five years at $15 per lamp per year per 30-cp light. This disposes of the question of municipal ownership of a lighting plant, which was under consideration here.

PASSAIC, N. J.—The City Council has awarded the contract for lighting the city streets for five years and furnishing the incandescent lamps to the Weehawken Construction Company at the following bid: Arc lights, $88 each per year; incandescent street lights, $15 per year; incandescent lighting for public buildings, 10 cents per kw-hour; incandescent lighting to private individuals, not more than 10 cents per kw-hour. The company agreed to erect and have in operation within eight months from the date the contract is signed a complete and modern plant.

ALBUQUERQUE, N. M.—Jos. C. Bonner, of Toledo, Ohio, is stated to have completed arrangements with capitalists of Albuquerque to utilize the power of the falls of Pecos River to furnish electric light and power to the cities of Santa Fe, Albuquerque and Las Vegas.

LIVONIA, N. Y.—F. A. Wicker, B. C. Black and Elbert Long are interested in the construction of an electric light plant.

CANANDAIGUA, N. Y.—There is some talk here of constructing a municipal electric light plant. The subject may come before the taxpayers at the annual election in February.

BUFFALO, N. Y.—The Phelps Light Company has been incorporated with a capital stock of $50,000. The directors are William Hooker, Batavia, and E. W. Phelps and W. E. Hooker, Buffalo.

HARRISVILLE, N. Y.—The Harrisville Electric Light & Power Company has been incorporated with a capital of $10,000. Directors: Thos. J. Wilbur, Jos. Weekes, Sr., and J. E. Harney, of Harrisville.

NORTH TONAWANDA, N. Y.—The Home Electric Light & Power Company has petitioned the Board of Aldermen for a franchise for lighting and power purposes. It will use the poles of the Niagara County Home Telephone Company.

ALBANY, N. Y.—The Northern Westchester Light & Power Company, of New York City, has been incorporated with a capital stock of $5000. The directors are R. S. Hull, Brooklyn; A. S. Andrews, Flushing, and John Larkin, New York.

NEW YORK, N. Y.—The Board of Estimate has authorized Corporation Counsel Delany to prepare an amendment to the charter, to be presented to the coming session of the Legislature, providing for the establishment of a municipal electric lighting plant.

BROOKLYN, N. Y.—The following are the totals of bids opened on Nov. 23 by Geo. E. Best, Commissioner of Bridges, for furnishing and installing two 120-hp. steam engines and two 75-kw direct-current generators at the Brooklyn Bridge power house on Main St.: Thompson, Bonney Co., $4925 (awarded contract); The Reeves Engine Co., $4950; Sprague Electric Company, $4977; A. D. Granger Co., $5331; Buffalo Forge Co., $5355; F. McSwegan & Son, $5400; Edwin Burhorn, $5555; Motley, Green & Co., $5600, and D'Olier Engineering Co., $5738.

TARBORO, N. C.—The city light plant at Tarboro was recently destroyed by fire, the loss being $3000.

ASHEVILLE, N. C.—The city authorities are considering a plan to convert the old pumping station into an electric light plant, at a cost of from $25,000 to $50,000.

RALEIGH, N. C.—The trustees of the Agricultural and Mechanical College have petitioned the Legislature for $30,000, with which to install a plant for furnishing light, heat and power.

HIGH POINT, N. C.—The Board of Aldermen of High Point will shortly consider a proposition to sell the electric light plant, which, it is said, has not proven a paying investment to the city.

WINSTON, N. C.—Judge Brown, of Ohio, now of Winston, is considering the developing of a water power on Dan River and possibly the construction of an electric railway from Walnut Cove to neighboring iron mines.

IRONTON, OHIO.—The Board of Public Service is considering the advisability of installing an electric plant at the city water works.

TOLEDO, OHIO.—It is stated that Mayor Finch and the Board of Public Service have now under consideration a plan by which a municipal lighting plant for lighting the city's streets will be located at the proposed filtration plant.

PHILADELPHIA, PA.—The only bid received and opened on Dec. 12 for electric lighting the city for 1905 was submitted by the Philadelphia Electric Company. The bid to light the entire city aggregates $1,137,509, and the prices range from 28c. to 34c. per light per night. There are to be next year 10,312 electric arc lamps.

CHAMBERSBURG, PA.—The Borough Council has accepted the bid of Charles Walter, representing the Chambersburg Light, Heat & Power Company, at $75,550, for the electric light plant, which the borough has owned and operated for 15 years. The company entered into a contract to light the streets of the town at $74.50 a year for each arc light.

MARION, S. C.—A charter has been issued to the Carolina Water, Light & Power Company, of Marion, which proposes to instal power plants in South Carolina and elsewhere; capital, $250,000. Incorporators: J. W. Johnson and W. J. Montgomery.

OBION, TENN.—Jas. F. Darnell, J. W. Buchanan, and others, have formed a company with a capital of $6000, to construct an electric light plant.

MEMPHIS, TENN.—The committee on gas and electricity of the Legislative Council has under consideration the municipal ownership of an electric light plant.

AMERICAN FORK, UTAH.—The Utah County Light & Power Company is said to be preparing plans for an auxiliary electric light and power plant in the American Fork Canyon, to cost about $150,000.

SALT LAKE CITY, UTAH.—A steam plant for the operation of its system is to be constructed by the Utah Light & Railway Company, which has outlined, besides this, numerous other improvements to be made during the next year. The estimated cost of the plant is $200,000.

NORTHFIELD, VT.—J. H. Talbot, village clerk, writes in regard to rebuilding the electric light plant which was recently burned that the plant will probably be constructed within a year. The village will contract with Moody & Almon to furnish electricity for one year.

BURLINGTON, VT.—The Northern Electric Company, of this city, has been awarded the contract to equip Fort Ethan Allen with electric lights. The contract price is $24,039 and the job must be completed in 90 days. For furnishing the power, the Burlington Light & Power Company was awarded the contract, the price being $78 per year for each arc light, of which there are about 20, and five cents per kw-hour.

SEATTLE, WASH.—The citizens voted on Dec. 6 to issue $250,000 in bonds for the extension of the present municipal electric light plant. R. H. Thomson is city engineer.

PROSSER, WASH.—E. F. Benson has secured a controlling interest in the Land & Irrigation Company, and expects to instal an electric light plant. An electric road may be built to Sunnyside.

HARPER'S FERRY, W. VA.—The Harper's Ferry Electric Light & Power Company is making preparations to supply the town of Brunswick with electric light.

ALMA, WIS.—The Alma Electric Light Company, of Alma, has been incorporated; capital $5000. Incorporators: John Harry, Russell N. Smith, Frank Harry and Charles Schaettle.

LA CROSSE, WIS.—Henry A. Salzer is one of the stockholders of a new independent lighting company which is about to petition the City Council for a franchise. The capital of the company is $200,000.

ST. THOMAS, ONT.—The City Council of St. Thomas has decided to submit a by-law to the ratepayers of the city at the approaching municipal election, for the purpose of raising the sum of $200,000 to purchase the gas and electric light plants now in operation in the city. The price to be paid is $205,397.

TORONTO, ONT.—The cities of Toronto and Toronto Junction will have power and light from other sources than Niagara Falls and the Humber River. The Credit River is now being dammed at Erindale, and poles have already been erected. The scheme is to tunnel, during the winter, under Erindale for about 900 feet. The opening of this tunnel will be 18 feet below the level of the water in the dam, and will have a head of 30 feet. The cost of the scheme is placed at $250,000. It is said that about 20,000 to 50,000 electrical horse-power will be generated.

FORT WILLIAM, ONT.—The electric power at Kakapecca Falls, a few miles from the city of Fort William, Ont., is to be developed by Montreal capitalists. The water from these falls has a drop of 125 feet, and the rights belonged to Chicago people who have sold them to Herbert S. Holt, president of the Montreal Light, Heat & Power Company, Chas. R. Hosmer and F. W. Thompson. It is understood that arrangements have been made for the immediate construction of a plant that will produce 30,000 electrical horse-power at the start, and 50,000 horse-power later.

MONTREAL, QUE.—The town of Westmount, a separate municipality having a population of about 10,000, but a suburb of Montreal, by vote has decided to establish a plant to produce electric light, independent of the Montreal Light, Heat & Power Company. The Ottawa civic committee, which has been looking into the purchase of the electric street railway of the city for the sum demanded by the Ottawa Electric Company, namely, $3,000,000, has recommended that a by-law be prepared for submission of the project to the property owners of the city at the municipal election to be held in January next.

THE ELECTRIC RAILWAY.

ROCKVILLE, CONN.—The contract for the construction of the Rockville, Broad Brook & East Windsor Street Railway has been taken by Thomas C. Perkins, of Hartford.

NEW LONDON, CONN.—The East Lyme Street Railway Company has changed its name to the New London & East Lyme Railway Company, and has awarded the contract for building its proposed line to the National Construction Company.

NEW HAVEN, CONN.—In an official announcement made by the New Haven road is contained information relative to petitions it will present to the incoming General Assembly for trolley extension in Connecticut. It will ask the Legislature for power to extend its Baltic line from Norwich to Jewett City; its line from Portland to Glastonbury to complete its Middletown-Hartford link; to build a connection from Middletown to Westfield; to connect the Meriden trolley with the Connecticut Railway & Lighting Company at Berlin, and to make a number of extensions in several cities in the State.

ATLANTA, GA.—Papers have been drawn up in Atlanta for a charter for the Athens, Floral Park & Newman Air Line Railway Company.

INDIANAPOLIS, IND.—The surveyors of the Indianapolis, Logansport & South Bend Traction Company have completed the survey of that road from Logansport to Mishawaka, Ind.

TERRE HAUTE, IND.—The Terre Haute Traction Company claims to have secured by purchase the right of way for an interurban railway from this city to Paris, Ill., a distance of 20 miles.

PRINCETON, IND.—The Pocket Electric Railway Company, recently organized here, has announced its intentions of constructing a line from Princeton to Petersburg, Ind. A large part of the right of way for the line has already been secured.

INDIANAPOLIS, IND.—At the annual meeting of the stockholders of the Columbus, Greensburg & Richmond Traction Company the directors elected the following officers: Harris F. Holland, president; Walter McConaha, vice-president; Albert H. Carter, secretary; Wm. P. Meyer, treasurer.

BLUFFTON, IND.—The Inter-State Traction Company has filed articles of incorporation with the Secretary of State, with a capital stock of $150,000. The principal incorporators are F. M. Caldwell, John H. Painter, John C. Curtis, E. L. Murray, J. S. Postal, A. G. King, A. L. Sharpe, of Bluffton, and C. H. Bandy, of Marion.

OAKLAND, ME.—The contract for building the Somerset Railway Company's line has been awarded to J. S. Kaulbach & Company, of New York. Henry F. Hill, of Bingham, Me., is chief engineer of the company.

WORCESTER, MASS.—The American Loan & Trust Company, of Boston, has filed a bill of complaint in the Superior Court against the Hampshire & Worcester Street Railway Company, declaring that the concern is insolvent and asking that a receiver be appointed. The American Loan & Trust Company holds bonds in the street railway to the amount of $200,000.

MAYNARD, MASS.—At the annual meeting of stockholders of the Concord, Maynard & Hudson Street Railway Company the following-named directors were elected: C. H. Persons, of Maynard; W. R. Dame, of Clinton; Charles W. Shippee, of Milford; Jerome Marble, of Worcester; Eugene H. Mather, of Boston; Henry Tower, of Hudson; Alonzo Tower, of Concord; Julius Loewe, of Maynard; John W. Ogden, of Maynard. The directors organized by electing the following-named officers: Chas. H. Persons, president; Alonzo Tower, vice-president; Henry Tower, treasurer; John W. Ogden, assistant treasurer, clerk and superintendent; Eugene H. Mather, chairman; Chas. H. Persons, Henry Tower, executive committee.

HATTIESBURG, MISS.—G. L. Hawkins and associates have secured from the city a franchise to erect and operate an electric light and railway here. It is reported that J. T. Jones, president of the Gulf & Ship Island Railroad, is interested.

MISSOULA, MONT.—This city and Bonner are to be connected by an electric railway according to plans of W. A. Clark, of Butte. An electric power plant is also to be established near here.

OMAHA, NEB.—The Omaha, Lincoln & Beatrice Electric Railway is perfecting its plans for building the proposed road. Henry Robinson and Harvey Musser, of Akron, Ohio, are interested in the company.

JERSEY CITY, N. J.—The New York Railroad & Development Company has been incorporated with a capital stock of $1,500,000. The incorporators are Robert C. Moore, Nehemiah B. Campbell and Wesley M. Oler.

ROCHESTER, N. Y.—The General Electric Company has received the contract to equip the new power house of the Rochester, Syracuse & Eastern Railroad Company at Lyons. The capacity of the plant will be 7500 horse-power.

ALBANY, N. Y.—The Buffalo & Rochester Railway has been incorporated with the Secretary of State, to operate a street electric road 60 miles long from the village of Depew, Erie Co., to Rochester, N. Y. Capital, $3,000,000. The directors are Henry H. Kingston, J. Andrew Harris and John J. Collier.

BALLSTON, N. Y.—The Eastern New York Railroad Company has been incorporated with a capital stock of $100,000 to operate an electric road 10 miles long from Ballston to Middle Grove, Saratoga County. The directors are F. F. Barrett, Saratoga; Fred A. Beach and B. S. Cole, Ballston, and T. R. Heller, Somerton.

PAINTED POST, N. Y.—The Corning & Painted Post Street Railway Company has passed into the hands of the Powers & Mansfield Company, of Troy, N. Y. The following are the officers of the company recently elected: J. A. Powers, of Troy, N. Y., president; G. Tracy Rogers, of Binghamton, N. Y., vice-president; W. H. Mansfield, of Troy, N. Y., treasurer and general manager; Thomas O'Connor, of Waterford, N. Y., secretary.

SYRACUSE, N. Y.—The State Railroad Commission has approved the application of the Syracuse, Skaneateles & Moravia Railroad Company for permission to issue a first mortgage for $1,500,000, on condition that not more than $500,000 in bonds be issued without further application for authority. The proceeds of the bonds are to be used for the building of the electric railway from Moravia to Syracuse. The promoter of the enterprise is Wing T. Parker, of Moravia. The company has been trying for four years to receive the permission from the Commissioners.

RALEIGH, N. C.—The Raleigh-Durham Passenger & Power Company has been organized to build an electric railway between Raleigh and Durham, two belt lines in Raleigh, a line in Durham, a light and ice plant for city, a pleasure park and possibly a hotel between the two cities. B. S. Jerman, of Raleigh, is president; W. J. Nelms, of Newport News, Va., vice-president; Thos. S. Fuller, of Raleigh, secretary and treasurer.

GALION, OHIO.—The promoters of the Galion Southern Railway claim to have formed plans for building the road next year. It will connect Galion, Mansfield and Mt. Vernon.

HILLSBORO, OHIO.—Edwin G. Orr, chief promoter of the proposed line from Wilmington to Hillsboro, states that the work of securing right of way is about completed, and it is expected that the road will be built next year. Dayton people are promoting the road.

CINCINNATI, OHIO.—It is reported that the officials of the Cincinnati, Dayton & Toledo Traction Company have about closed a deal whereby they will secure about $1,500,000 for betterment purposes. This will probably be done by increasing the bond issue from $3,500,000 to $5,000,000.

CLEVELAND, OHIO.—It is said that George A. Bishop, of Cleveland, and his associates in the Northern Ohio Traction Company are considering the question of financing the Baltimore, Annapolis & Washington Railway. This company was organized to build a single-phase line between Baltimore, Annapolis and Washington, and after beginning work became involved in financial difficulties.

COLUMBUS, OHIO.—The Cleveland, Wooster, Mt. Vernon & Columbus Railway Company, of Mt. Vernon, has been incorporated, with $10,000 capital stock. The incorporators are J. J. Vail, James B. Graham, J. A. Tillen, Fred W. Jones and E. r. Skelley. The company proposes to build an electric railway from Wooster by way of Mt. Vernon to Columbus. At Wooster, connection will be made with the Cleveland & Southwestern Traction Company's line for Cleveland.

PITTSBURG, PA.—The Tarentum & Breckenridge Street Railway Company has had organized and will present an ordinance at the next meeting of Tarentum Council asking for a franchise.

SHARON, PA.—H. M. Adams, of Cleveland, C. G. Hussey, of Pittsburg, and W. H. Waugh, of Greenville, have asked Council for a franchise for an electric railway. The intention is to build a line from Meadville to New Castle. Murry A. Verner, of Pittsburg, is one of the promoters.

TAMAQUA, PA.—The Tamaqua & Lansford Street Railway Company contemplates extending its line westward through Tamaqua to connect with the Pottsville Union Traction Company's branch at Middleport, which is its eastern terminus. When the proposed extension is made the Tamaqua & Lansford Street Railway Company's tracks will extend from Middleport to Mauch Chunk, a distance of about 25 miles. The main power house will remain in Lansford, but it is very probable that a sub-station will be erected some place west of Tamaqua.

HARRISBURG, PA.—Street railway corporation charters have been issued at the State Department as follows: Bridgeville Street Railway Company, 10 miles long, in Scott Township, Allegheny County. Capital, $60,000; president, A. J. Barron, Pittsburg. Marshall Avenue Street Railway Company, 6 miles, from Perryville and Marshall Avenue to Pittsburg. Capital, $36,000; president, William Kaufman, Allegheny. Huntingdon Street Railway Company, of Huntingdon, to run from Huntingdon to Smithfield, Petersburg, Alexandria, Alfarata and Mount Union, 30 miles. Capital, $180,000; president, Elmer E. Davis, Johnstown. Greenville Street Railway Company, 4½ miles, over streets of Greenville. Capital, $26,000; president, Curtis G. Hussey, Allegheny. Watson Street Railway Company, Allegheny, 1½ miles. Capital, $9000; president, William Kaufman, Allegheny.

SUFFOLK, VA.—A street railway franchise has been granted to L. R. Britt, George H. Lewis, W. D. Southall, W. H. Robinson and Geo. L. Barton for the construction of an electric railway here. For further information write to Lee Britt, Suffolk, Va.

SPOKANE, WASH.—The Spokane Southern Traction Company, promoted by Mark F. Mendenhall, of this city, is increasing its capital stock from $500,000 to $2,000,000, and will build across the Palouse country to Colfax.

AROOSTOOK JUNCTION, N. B.—The New Brunswick Electrical Power Company has had surveys made with the object of developing the power of Aroostook Falls. It is estimated the 4000 horse-power can be obtained with a comparatively moderate expenditure of capital. The power will be used for the operation of an electric railway to be built from Presque Ile to Washburn and Perham, and for furnishing electric light and power.

ST. THOMAS, ONT.—The Southwestern Traction Company, which is building a line between London and Port Stanley, is negotiating with the St. Thomas Council for the purchase or leasing of the city's street railway.

HAMILTON, ONT.—An electric radial railway between the cities of Brantford and Hamilton is now an assured enterprise. Messrs. Parsons and Leslie, of Toronto, Ont., together with the Hon. Mr. Haines, of New York, are the principal promoters of the undertaking. They form what is known as the Hamilton, Ancaster & Brantford Radial Company. The road is being surveyed and construction work will begin early in the spring.

MONTREAL, QUE.—The Montreal Street Railway has given an order for 25 additional cars, the same to be constructed in its shops at Hochelaga. The order for the first 50, upon which work began in February, 1904, is now completed.

NEW INDUSTRIAL COMPANIES.

THE BLAKE ELECTRIC COMPANY, of Boston, has been incorporated with $10,000 capital. President, Frank R. Blake; treasurer, Hugh A. Quinn.

THE VIRGINIA AUTOMOBILE COMPANY, of Norfolk, Va., has been chartered to build and lease automobiles, etc. Moses Nusbaum is president and the capital stock is $25,000 maximum.

THE EFLOR ELECTRIC COMPANY, of Rochester, N. Y., has been formed to furnish machinery and supplies; capital, $10,000. Incorporators: C. D. Rolfe, John D. Lynn, Smith O'Brien, Rochester, N. Y.

THE INDEPENDENT INSULATOR COMPANY, of New York City, has been incorporated with a capital stock of $250,000 for the purpose of manufacturing glass insulators. The directors of the company are Milton Greenebaum, New York City; C. Hull, Brooklyn, and H. M. Wells, Passaic, N. J.

THE SYRACUSE TERMINAL ASSOCIATION, of Syracuse, N. Y., has been incorporated with a capital stock of $25,000 to purchase street railroad terminal property. The directors are H. J. Clark, T. H. Mathey and W. H. Hardy, Syracuse.

THE ELECTRIC SUPPLY COMPANY, of Sacramento, Cal., has been formed to purchase and take over the business of which C. V. Schneider is the owner by H. G. May, J. C. Hobrecht, C. V. Schneider and others. Capital stock, $10,000.

THE AUCK ELECTRIC COMPANY has been formed in Philadelphia to manufacture a mercury arc lamp under the patents of John M. Auck, of Philadelphia. The officers of the company are J. M. Auck, president and treasurer; W. Auck, vice-president; John S. Carter, secretary. The present office address is 2002 West Twenty-first Street, Philadelphia.

THE NATIONAL ELECTRICAL CONSTRUCTION COMPANY has been organized at Portland, Me., for the purpose of carrying on the business of electricians, mechanical engineers and manufacturers, and workers and dealers in electricity, motive power, heat and light, etc., with a capital stock of $500,000. The officers of the company are: President, Millard W. Baldwin, Portland; treasurer, Geo. C. Knight, Portland.

LEGAL.

RESTRICTION ON MUNICIPAL PLANT.—The U. S. Circuit Court of Appeals decided recently an appeal from the Circuit Court of the United States for the Western District of Missouri to review a decree enjoining a municipality from entering into the business of commercial electric lighting. The lower decision was reversed and remanded for the dismissal of the bill. The appeal court held that an implied contract that the city will not, for 20 years, enter into the business of commercial electric lighting, does not arise from a municipal grant to certain persons under the authority of Mo. Laws 1891, p. 60, of the right to erect and maintain an electric light plant for that period, where such grant is not exclusive.

CONTROL OF WIRELESS PROPERTIES.—Dr. Gustave P. Gehring, of 46 Manhattan Ave., New York, says he is the inventor of several wireless telegraph patents, and organized and practically controlled the International Wireless Telegraph Company, to which he sold his patents and the privilege of using them. Now he owns, he says, several thousand shares of the American De Forest Wireless Telegraph Company, which absorbed the International, and he alleges that his rights and those of the other stockholders, along with the properties of the company, are being imperilled by the tactics of its president, Abraham White, and its treasurer, Francis X. Butler. Mr. Butler is a member of the law firm of Knabe & Butler, who are counsel for the American Company. Supreme Court Justice Truax has at present under consideration a motion made by Mr. Butler to vacate, on technical grounds, an order recently obtained by Dr. Gehring's counsel, John J. Vause, for the examination, before trial, of both White and Butler. If they do not succeed in having the order for their examination set aside they must produce the books of the American De Forest Company for inspection. Dr. Gehring alleges that, according to his information, part of which, he says, was derived from White himself, there is a deal now pending by which the patents, privileges and properties of the American Company are to be turned over to the Greater New York Security Company by its officers, without adequate consideration. The Greater New York Security Company was recently, on its own motion, joined as co-plaintiff in the suit of Henry Gardner, a yet unidentified person, against the Marconi Wireless Telegraph Company.

OBITUARY.

MR. W. FORMAN COLLINS.—Just as we are going to press we are in receipt of the news of the sudden death of Mr. W. Forman Collins, in Chicago, on Dec. 21. Mr. Collins was well-known among the electrical fraternity in New York, Boston and Chicago, and was for several years connected with electrical journalism.

MR. P. D. CONNOR.—Paul D. Connor, Sr., said to have been the oldest living telegraph constructor, died at his home in Washington, D. C., last week at the age of 72 years, after a short illness. In the early days young Connor aided Professor Morse in putting up the first telegraph line, that between Baltimore and Washington. Later he was actively engaged in the construction of the famous Cabin John Bridge, one of the aqueducts which help to bring the city's water supply from Great Falls. He was also employed during the Civil War in stringing wires in the vicinity of the capital, and the government afterward recognized these services. After the war he worked with the Southern Telegraph Company, conducting the Washington construction work. When the Western Union Telegraph Company was organized he was secured to superintend that end of its construction work. With Mr. Geo. C. Maynard he also helped to put the first telephone wires in Washington. Mr. Connor was a member of the U. S. Military Telegraphers' Association. He was known for his kindliness and charitable disposition, and, it is said, was instrumental in starting many boys as telegraph messengers, who now hold responsible positions.

PERSONAL.

O. A. STRANAHAN.

MR. O. A. STRANAHAN.—Another strong addition to the Allis-Chalmers staff is M. O. A. Stranahan, who has been appointed manager of the power department of the Allis-Chalmers Company, and will have charge of the sales of reciprocating engines, gas engines and steam turbines. Mr. Stranahan has been, for the past three or four years in charge of the engine business of the British Westinghouse Electric & Manufacturing Company, and in that work has met with marked success. He has given much attention to gas engine developments, particularly with regard to producer and blast furnace gas. Mr. Stranahan graduated from Cornell in 1890, and immediately thereafter entered the service of Westinghouse, Church, Kerr & Company, working up through their various departments, and becoming chief engineer of their Chicago office. When the British Westinghouse Company was formed Mr. Stranahan was appointed to the charge of their engine business. He began these duties in 1900, and was engaged in them up to the time of his appointment by the Allis-Chalmers Company. Mr. Stranahan has not only a very wide business acquaintance throughout the United States, but his work abroad has given him an extensive European connection. His new appointment dates from December 1. He arrived in New York from England about the middle of December, and proceeded at once to Milwaukee where he will establish his headquarters.

MR. FRANCIS BLOSSOM, of Sanderson & Porter, Kuhn-Loeb Building, has returned this week from a trip to Europe.

MR. H. H. PORTER, JR., of the New York electrical engineering and contracting firm of Sanderson & Porter, is back from a trip to California.

MR. JOSEPH E. LOCKWOOD, of Detroit, has been at Bay City, Mich., recently, as an expert for the city in its suit with the Bay City Traction & Electric Company.

M. BLONDLOT will publish through Longmans, Green & Company, early next year, a translation of Mr. Blondot's papers on the much-discussed N-rays. The original papers will be annotated.

MR. C. W. WHITNEY has accepted a position with the Abner Doble Company, of San Francisco, electric power transmission engineers and designers and manufacturers of the Doble tangential water wheels.

MR. AUGUST BELMONT, now so largely interested in electric traction has been elected president of the National Civic Federation. The leadership in this peace-making industrial organization was left vacant by the death of Senator Hanna.

MR. J. J. ESTERBROOK, formerly traveling representative of the Holtzer Cabot Electric Company, of Brookline, Mass., is now manager of the New York offices of the company which have removed to more commodious quarters at 143 Liberty Street.

MR. D. W. COONS has disposed of his interest in the Los Angeles Electrical Specialty Company, of Los Angeles, Cal., and is no longer connected with the concern. He has gone to St. Louis and after a short period of rest will look around for some new business connection.

MR. W. K. PALMER.—The city of Coffeyville, Kan., has engaged W. K. Palmer, consulting engineer, Dwight Building, Kansas City, Mo., to prepare plans and specifications for rebuilding the city's lighting plant and lighting system and to superintend the construction.

MR. J. B. McCLARY, who recently resigned the management of the railway department of the Birmingham, Ala., Railway, Light & Power Company, has accepted the position of general manager of the company at Sheffield, including the public utilities of that town, Tuscumbia and Florence.

MR. JOHN F. SKIRROW has been made associate electrical engineer of the Postal Telegraph Cable Company to date from January 1. This is a new position in the Postal organization created virtually for Mr. Skirrow, who is to be congratulated on this mark of esteem and approval on the part of the corporation.

PROF. A. G. BELL has taken up the cause of the colored man and has complained to the U. S. State Department of the inhospitable treatment extended to a negro servant of his for whom he had found it difficult or impossible to obtain hotel accommodation at Cape Breton, N. S., where the Bell summer home is situated.

MR. WILLIAM ALBERT HALL, 145 East 4th Street, Cincinnati, Ohio, in addition to the other agencies he has secured, is now representing the Standard Electrical Mfg. Company, of Niles, Ohio, for its lamps. Mr. Hall has had great success in his vicinity in handling various electrical specialties and the Standard lamp more nearly completes his line.

MR. W. B. DEVEREAUX has been engaged by Col. W. C. Greene, president of the Greene Consolidated Copper Company, regarding the proposed

30,000-hp hydraulic plant to be built on the Arros River, State of Sonora, Mexico, for the purpose of operating large smelters, mills, etc. Power will be transmitted about 150 miles. Mr. Devereaux is already on the ground.

MR. FRANK M. TAIT, general manager of the New London Gas & Electric Company, and the Oneco Mfg. Company machine shops, of New London, Conn., has resigned and will associate himself with the Dayton (Ohio) Electric Light & Power Company as general manager dating from January 1, 1905. During Mr. Tait's connection with the New London Company he reconstructed all the plants and made an unusual success of his work.

EIDLITZ-WARD.—Miss Carol Dudley Eidlitz, daughter of Mr. and Mrs. Cyrus L. Eidlitz, of New York City, and Alexander Ladd Ward were married on December 14, at Christ Protestant Episcopal Church, this city. Miss M. D. Eidlitz was maid of honor, while the bridesmaids were the Misses E. Ward, E. Ladd, E. V. Brander Matthews and E. Toucey. Mr. S. Wentworth was the best man, and the ushers were Messrs L. T. Dyer, H. M. Brookfield, W. Emerson and Dr. E. V. Hubbard. Mr. Eidlitz is receiving the congratulations of his innumerable friends in the electrical field.

MR. GANO S. DUNN, chief engineer of the Crocker Wheeler Company, has just returned from San Francisco, where, as already noted, his company has closed one of the most important contracts of the year. The California Gas & Electric Corporation has placed an order for three 4000-kw, 3 phase, revolving field alternators, to be driven by 6000-hp gas engines. These generators are the largest in capacity in the world driven by gas engines, and will furnish power for operating all the street railways in San Francisco and vicinity. This important sale by a company which has been building alternating current machinery only a few months is indeed a cause for comment, and Mr. Dunn is to be congratulated upon his personal share in the contract.

MR. GEORGE WESTINGHOUSE has a remarkable power over men, according to Theodore Nevin, who writes of him in the January *World's Work*. An incident demonstrating this occurred in the president's office in one of the largest Pittsburg banks a few years ago. The president's private telephone rang several times, and finally answering it, the president said, "Mr. Smith is not in now." A visitor hearing the remark, looked astonished, and asked, "Mr. Smith, why did you tell him that you were not in?" Mr. Smith answered: "That was Mr. Westinghouse at the other end of the line. He is a peculiar man and has a marvelous influence over other men. It is impossible to refuse him when he asks for anything. He wants me to come to see him, and if I should go and he should ask me for a large sum of money I would let him have it. And we are not now in a position to make the loan."

GEN. THOMAS SHERWIN, president of the New England Telephone & Telegraph Company, addressed the directors of the Boston Merchants' Association at Young's Hotel, December 14, upon the subject of telephone service. He gave an interesting sketch of the invention of the telephone and its remarkable increase in public use, and then in reply to questions regarding rates, pointed out that Boston enjoys an unlimited service in comparison to measured service in New York and other large cities. He stated that there is no known way to prevent cut-offs during conversations because operators are not infallible, being human. As to the reason for the higher cost of service per station in a large city as compared with a small city, the answer was the increased cost of construction, increased depreciation and greater cost of operation. In answer to the question as to whether the public might not look forward to reduced rates now that the necessarily large expense of experimenting had been met, Gen. Sherwin pointed out that the public should realize that it is constantly receiving extended service for the money paid, which indirectly reduces the cost.

MR. JOHN B. McDONALD has been elected a member of the executive committee and vice-president of the Metropolitan Securities Company, of New York. Mr. McDonald and his friends purchased sufficient stock of the Securities Company to entitle them to representation on the board and he will have charge of the Metropolitan's proposed tunnel construction. He says: "The Metropolitan Railway system has in operation surface lines reaching the bridges constructed and to be constructed over the East River, the ferries on both rivers, the stations of the great railways entering the city, and almost every section of the city by lateral and cross-town lines. Connect this system with Rapid Transit Subways, with one fare to all points, and Rapid Transit express service with local distribution will be realized for the people of the City of New York. Believing that this great improvement can be best accomplished by the company controlling the surface lines, I have made this new connection in the conviction that through that system and its proposed underground extensions, New York will secure perfect rapid transit. I am encouraged in this direction by the assurances received that not only financial support, but all that engineering skill and electrical science can accomplish will be given."

MR. T. A. EDISON will be going south to his Florida plantation soon. He was holding an electrical conference at his West Orange laboratory with the heads of departments, when he learned that a contributor to *Country Life in America* was without, desiring to know the orthodox snell (the point of juncture between the fish hook and line). At once his office was opened, and the problem of belting the world with light was dropped for a consideration of the relative pliability of leather and piano wire. "Tarpon-fishing," he said, "is better than all other kinds of fishing because of those silver leaps. I have seen tarpon jump 20 and 30 times after being struck, and then the bait goes flying across the water a hundred feet. They certainly clear five feet in height—I have seen a seven-foot fish make it. The authenticated reports give their weight as more than 200 pounds, and I have seen them tip the scales at 185 pounds. No, I never catch the first tarpon" (there is an agreement among New York sportsmen that Mr. Edison ushers in each season with the first catch). "John Paul Jones does that each year. He's a native, down there. But last year a northern dude came down, who didn't know how to fish. John Paul Jones had been out day after day, but hadn't made a catch. And this dude on his first ignorant day caught a big fellow, and started the season. I like a chain next to my hook. But I let them fix me up as they want to. Is it sport?" Mr. Edison raised both hands over his head to prove that the joy of it to the initiated is inexpressible.

Trade Notes.

THE U. S. METAL POLISH, which is manufactured by George William Hoffman, of Indianapolis, and the Barkeeper's Friend, which is a splendid preparation of its sort, has received from the Louisiana Purchase Exposition of St. Louis the highest award.

NORTH ELECTRIC COMPANY, Cleveland, Ohio, manufacturer of telephonic apparatus, has established a branch house at Dallas, Tex., which was opened for business on December 15. This branch house is in charge of Mr. A. A. Miller, who has been connected with the sales department of the company at Cleveland for some time.

A. L. IDE & SON.—One of the nicest exhibits at the St. Louis Exhibition was that of A. L. Ide & Son, in the Palace of Machinery. The manufacturers are to be congratulated on having very promptly disposed of the unit, the machinery having been taken from them by the Crane Company, of Chicago, within the past ten days.

ELECTRICAL NOVELTIES.—The Ewing-Markle Electric Company, St. Louis, Mo., in a recent catalogue, describes and illustrates a very full line of electrical novelties and appliances. These devices include electrical toys of all kinds and more serious apparatus, such as small power motors, fan outfits, telephone outfits, learners' telegraph outfits, electrical heating apparatus, etc. An interesting part of the pamphlet is the description and illustration of the electric light outfit for Christmas trees. This catalogue should be specially interesting at this time, on the approach of the holiday season.

TELEPHONE CABLE TERMINALS.—Although Frank B. Cook has been almost swamped with orders for his No. 444 protectors this is not the only type of apparatus which he manufactures that has met with popular favor. His type S. A. pole cable terminal has also been making a big hit. Orders have recently been received from the Easton & Bethlehem Telephone Co., Easton, Pa., for 77 of this type; from the Hawkeye Telephone Company, Des Moines, Ia., 13; from the Suburban Telephone Co., Clayton, Mo., 14. This terminal is very small and compact, and the galvanized iron cover protects all connections from the weather.

WESTERN ELECTRIC ARC LAMPS.—The Western Electric Company has issued three bulletins, Nos. 7030, 7035 and 7040, devoted, respectively, to multiple series and constant current arc lamps for direct-current circuits; multiple constant potential alternating current arc lamps, and multiple constant potential direct-current arc lamps. These different types of lamps are briefly described and well illustrated, with views of the lamps complete and the parts thereof. Diagrams show the connections between the lamps and the controlling devices. The pamphlets are gotten up in the company's usual first-class style, and are excellently printed on fine coated paper. The illustrations are very fine, and show the mechanical details very clearly.

STANDARD ENCLOSED FUSES.—The Chase-Shawmut Company, Newburyport, Mass., has issued its descriptive bulletin (No. 28) covering Shawmut National Electric Code standard enclosed fuses. These fuses are designed and made to conform to the latest specifications of the Underwriters National Board, whereby the product of the different manufacturers of this material must be interchangeable. That is to say, the fuses of a given class must be so constructed that it will be possible to use them in any other manufacturer's cut-out, made to conform to the National Electrical Code standard. The Chase-Shawmut Company has been working on this material for quite a long time and claims to be the first manufacturer to place the same on the market, having a complete line in stock for immediate delivery. The bulletin is very completely illustrated with views of the many different forms of enclosed fuses.

HOPE WEBBING FACTORY.—The new factory building of the Hope Webbing Company, at Pawtucket, R. I., measuring about 85 by 325 ft., presents an interesting application of the fan system of heating and ventilation. In connection with an old building, and contemplated additions, the total contents amount to about 875,000 cubic ft. In this installation, made by the B. F. Sturtevant Company, of Boston, Mass., the distributing ducts occupy no valuable space, for the heated air is forced through an underground system into vertical flues which are built into the brick walls. From these flues the air is admitted in the usual manner through openings placed about 8 ft. above floor level. With this arrangement, it is possible to concentrate all of the heating surface in a single fireproof casing in connection with the fan, and to eliminate from the entire building all extended systems of steam piping. The plenum system, under which the air is forced into the building, insures a continuous and invigorating supply which cannot fail to improve the health and efficiency of the workmen.

BROWN CORLISS ENGINE COMPANY, Corliss, Wis., has just received a contract from the City of Milwaukee to furnish and erect complete at the North Point pumping station, on the shore of Lake Michigan, a twenty million gallon triple expansion high duty crank and fly wheel pumping engine according to the plans and specifications prepared by the city, dated November 1, 1904, and according to plans and specifications submitted by the company. The total amount of contract is $64,500. This pumping engine has been the source of considerable discussion in the past three or four months, and practically all of the prominent engine and pump builders of the country have submitted bids on this contract. This would tend to show that the company is in a position to manufacture the largest type of engines, pumps, etc. The contract was awarded only after a thorough inspection of the manufacturing plant by City Engineer Charles J. Poetsch and the entire Board of Public Works. They inspected the plant one day and the following day awarded the the contract. The Brown Corliss Engine Company is now extending its foundry 60 feet, which has been found necessary to take care of the large amount of work on hand and in view.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED DECEMBER 13, 1904.

[Conducted by Rosenbaum & Stockbridge, Patent Atty's, 140 Nassau St., N. Y.]

777,067. AUTOMATIC FIRE ALARM TRANSMISSION; George B. Bowell, West Kensington Park, England. App. filed July 7, 1902. Details.

777,106. CASING FOR ELECTRIC PUSH BUTTONS; Henry F. Feil, Bronxville, N. Y. App. filed May 17, 1904. A metal casing and base are formed with co-operating parts so as to spring together without fastening screws.

777,116. AUTOMATIC RHEOSTAT; Tobert J. Louis, New York, N. Y. App. filed March 4, 1903. A resistance wire is wound upon a drum and a contact finger is caused to travel along the surface of the drum by a threaded shaft and nut.

777,118. EMERGENCY BRAKE; George Macloskie, Schenectady, N. Y. App. filed March 21, 1903. Automatic means for causing the brake to be applied whenever the motorman removes his hand from the controller in any of its positions; thus making it necessary for him to remain alert even when coasting.

777,124. MAGNET CONTACT FOR PROPULSION OF CARS; James M. Morgan, Toledo, Ohio. App. filed July 28, 1904. Magnets carried by a car and used to lift a circuit controller in the roadbed, are mounted upon a hinged frame provided with guides so that it will partake of the curvature of the track when the car is passing over curves therein.

777,146. ELECTRIC ARC LAMP; Lafayette E. Safford, Allegheny, Pa. App. filed Aug. 19, 1903. The magnet is composed of ribbon conductors wound one layer deep and edgewise, the turns being separated by insulating material; this makes a magnet refractory to heat.

777,148. MAGNET COIL; Albert Schweitzer, Pittsburg, Pa. App. filed May 18, 1904. Covers the construction of such a magnet as is used in the last mentioned patent.

777,153. CONTACT DEVICE FOR ELECTRIC SELF-PLAYING MUSICAL INSTRUMENTS; Irving B. Smith, Philadelphia, Pa. App. filed July 14, 1904. Each contact finger is in two parts, one preceding the other, so as to continue the contact permitted by the smaller perforations in the music strip.

777,164. ELECTRIC MAKE AND BREAK MECHANISM; James C. Waldo, Sharpsburg, Pa. App. filed Oct. 19, 1903. A switch-box applied to the trolley wire designed to be operated by the wheel.

777,172. TELEPHONE ATTACHMENT; Herbert G. Addie, Cresco, Ia. App. filed May 20, 1904.

777,194. VARIABLE SPEED DYNAMO; Arthur J. Farnsworth, New York, N. Y. App. filed Aug. 1, 1902. A constant-potential variable-speed dynamo having a field magnet excited substantially independent of speed variation, a second field magnet having an excitation varying with the dynamo speed and series connected conductors adapted to have variable movements relatively to each field, the field producing opposite effects in the conductors.

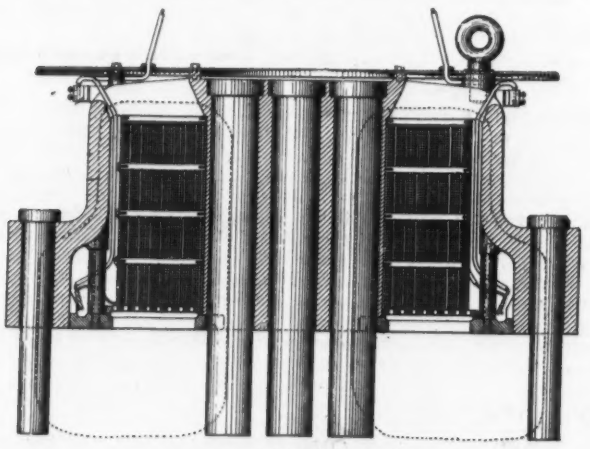
777,198. ALTERNATE-CURRENT MOTOR; Valere Alfred Fynn, Bradford, Eng. App. filed Sept. 17, 1903.

777,216. APPARATUS FOR WIRELESS TELEPHONY; Sigmund Musits, Steinamanger, Austria-Hungary. App. filed Nov. 24, 1902. Specific arrangement of circuits at a station.

777,217. TELEPHONE SERVICE-METER; Frank R. McBerty, Evanston, Ill. App. filed April 16, 1900.

777,221. LIFTING MAGNET; Stephen Piek, Buffalo, N. Y. App. filed Oct. 9, 1903. The magnet has a number of cores longitudinally movable independently of each other, so that their pole pieces can be adjusted to fit against an irregularly shaped body to be lifted.

777,246. RHEOSTAT; Henry H. Cutler, Milwaukee, Wis. App. filed Nov. 21, 1902. A thermostat is employed in connection with a rheostat to control safety devices employed to prevent overheating of the rheostat should its contact arm be left at an intermediate position.



777,221.—Lifting Magnet.

777,259. SUBMARINE TELEGRAPHY; Isidor Kitsee, Philadelphia, Pa. App. filed Feb. 5, 1904. A method of telegraphically transmitting messages consisting in impressing upon the successive impulses of opposite polarity, each successive impulse representing a telegraphic symbol, one symbol being distinguished from another by a difference in the time unit between two symbol elements.

777,290. VARIABLE INDUCTIVE RESISTANCE; Thomas B. Kinraide, Boston, Mass. App. filed May 25, 1904. A species of choke-coil having means for finely adjusting its air gap.

777,301. BUSY SIGNAL FOR TELEPHONE EXCHANGES; James L. McQuarrie, Chicago, Ill. App. filed April 1, 1901.

777,304. TROLLEY POLE; Andrew L. Prentiss, Buffalo, N. Y. App. filed Feb. 23, 1904. Details.

777,310. TELEPHONE DISINFECTING DEVICE; William H. Rose, Catonsville, Md. App. filed Sept. 3, 1904.

777,312. MULTIPLEX TELEGRAPH SYSTEM; Harry Shoemaker, Philadelphia, Pa. App. filed Jan. 18, 1904. Sunflowers at the various stations are kept in step with a master sunflower, not by a usual synchronizing impulse, but by each of the impulses transmitted over the circuit.

777,324. TELEPHONE SYSTEM; Charles Adams-Randall, Boston, Mass. App. filed Dec. 22, 1903.

777,327. CALL BOX; John C. Barclay, New York, N. Y. App. filed April 5, 1904. Details.

777,344. SASH FASTENER AND BURGLAR ALARM; Bedford T. Kavanaugh, Chicago, Ill. App. filed Feb. 18, 1904. The sash can be lifted and latched at any one of a series of points and an alarm sounded in case it is disturbed.

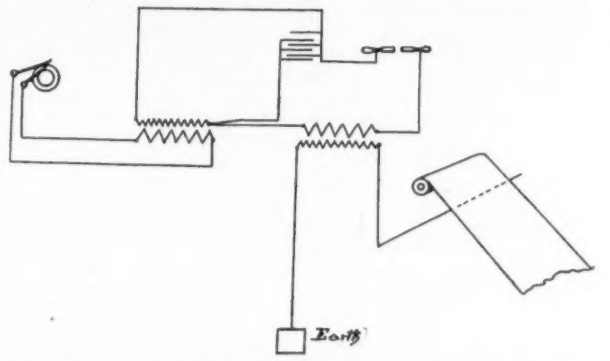
777,353. BLOCK SIGNAL SYSTEM; Tony Silvene, Victoria, Canada. App. filed May 19, 1904. Details.

777,429. PARTY LINE TELEPHONE SYSTEM; Walter Parker, Leicester, N. Y. App. filed Jan. 13, 1904.

777,439. RHEOSTAT; William L. Schmidt, Easton, Pa. App. filed June 7, 1904. A conducting drum and a non-conducting drum are arranged side by side and a resistance wire wound from one to the other to vary the resistance in circuit.

777,457. BATTERY CASE; Reinhold H. Wappler and Frederick H. Wappler, New York, N. Y. App. filed April 20, 1904. Spring contacts arranged to properly connect the cells when they are placed in the case.

777,468. HOLDER FOR TROLLEY WIRES; Frank M. Zimmerman, Aurora, Ill. App. filed Sept. 16, 1904. The pin projecting upward from the center of the clip, fits rotarily within the insulator.



777,598.—Method of Removing Static Electricity from Paper, Yarn, etc.

777,486. PROCESS OF MANUFACTURING NITRIC ACID; Harry Pauling, Brandau, Austria-Hungary. App. filed Aug. 12, 1902.

777,489. SPEED GOVERNING APPARATUS FOR ELECTRIC MOTORS; Hiram A. Bond, Springfield, Mass. App. filed Oct. 21, 1903. A ball governor on the motor shaft actuates a rheostat to control the speed of the motor.

777,490. ELECTRIC ARC LAMP; Hugo Bremer, Neheim, Germany. App. filed March 26, 1902. Mechanism for controlling electrodes which are arranged parallel or converging.

777,496. INDUCTION APPARATUS; George M. Christoph, Chicago, Ill. App. filed May 15, 1903. The weight of the secondary coils is taken from the core and sustained by the casing in which the coil is inclosed.

777,503. X-RAY TUBE; Robert Friedlander, Chicago, Ill. App. filed Sept. 12, 1904. A compound terminal arranged in the tube and comprising a gas absorbing and a gas evolving element.

777,506. THERMO ELECTRIC ALARM; Anton Haslinger, Allegheny, Pa. App. filed April 30, 1904. A thermostat is employed in connection with a gas stove to close an alarm circuit when the gas is flowing and not ignited.

777,510. PORTABLE LIGHT; Conrad Hubert, New York, N. Y. App. filed July 21, 1904. A battery casing having a lamp in its cover and conveniently arranged spring circuit closers.

777,535. BURGLAR ALARM; Joseph W. Pickens and Albert J. Ross, Jonesboro, La. App. filed Aug. 8, 1904. A circuit closer applied to a gate.

777,536. ELECTRIC CONTROLLER; Weston A. Price, Cleveland, Ohio. App. filed Feb. 24, 1903. A conductor is placed in a casing and an arm is arranged to make contact with successive portions of the conductor during its rotation, the number of rotations being indicated on the cover of the casing.

777,544. TELEPHONE SYSTEM; John G. Roberts, Detroit, Mich. App. filed Dec. 15, 1899.

777,555. ELECTRIC SIGNALING SYSTEM; Howell W. Souder, Tamaqua, Pa. App. filed July 28, 1903. Details.

777,581. TROLLEY POLE; John L. Young, Columbus, Ga. App. filed Aug. 26, 1904. Details of a lazy-tong pole.

777,583. SANITARY ATTACHMENT FOR TELEPHONE TRANSMITTERS; Henry Baethig, Buffalo, N. Y. App. filed April 25, 1903.

777,598. METHOD OF REMOVING STATIC ELECTRICITY FROM PAPER, YARN, ETC.; William H. Chapman, Portland, Me. App. filed Jan. 25, 1904. A method of neutralizing a charge of static electricity in a body, by passing it through a field of alternating static electricity.

777,599. APPARATUS FOR REMOVING STATIC ELECTRICITY FROM PAPER, ETC.; William H. Chapman, Portland, Me. App. filed Feb, 8, 1904. An apparatus for carrying out the preceding method.

777,607. MOUTHPIECE FOR TELEPHONE TRANSMITTERS; Arthur B. Cruikshank, London, Eng. App. filed July 27, 1904.

777,612. AUTOMATIC DANGER SIGNAL FOR ELEVATOR GATES; Charles T. Eaton, East Somerville, Mass. App. filed May 18, 1904. Details.

777,616. ELECTRIC TROLLEY; Theophile Euphrat, Norwalk, Conn. App. filed April 13, 1904. An ice-crushing wheel is carried on the trolley harp and when permitted to engage the wire, the contact wheel is removed from the wire.

777,631. SWITCH FOR ARC LAMP CIRCUITS; Robert H. Henderson, Newark, N. J. App. filed March 20, 1903. A switch provided with means for suppressing arcs that may be caused when an alternating current lamp or lamps is thrown into circuit.

777,637. RHEOSTAT; Charles H. Keeney and Charles A. Rhine, Milwaukee, Wis. App. filed Feb. 29, 1904. Improvements in starting boxes having an electro-magnetic lock for the switch arm.

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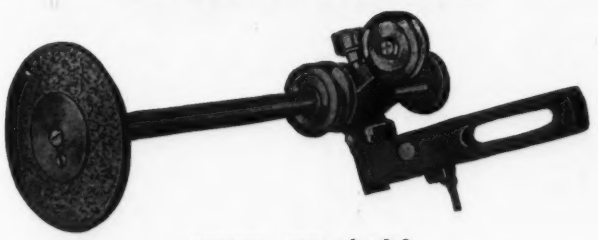

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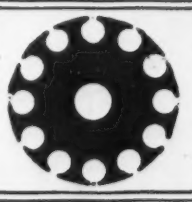

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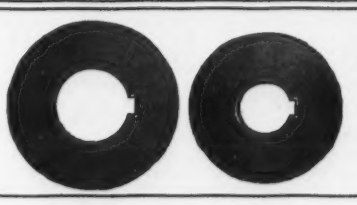

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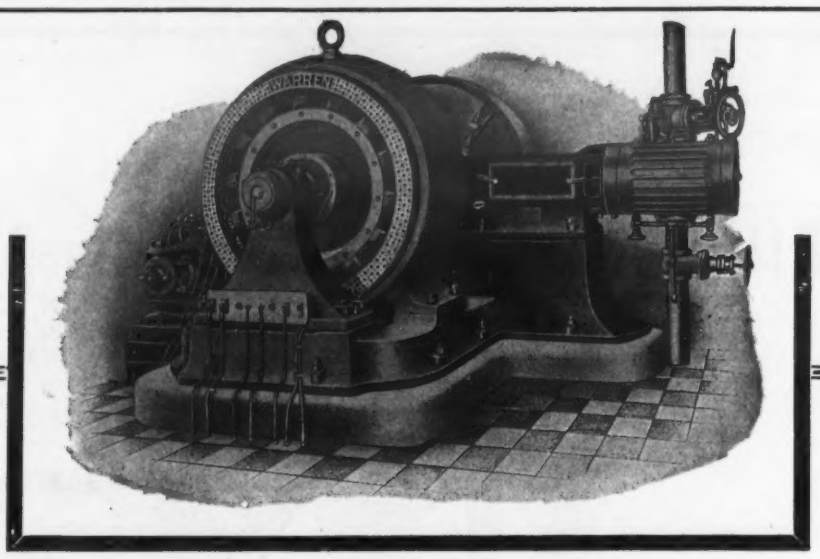

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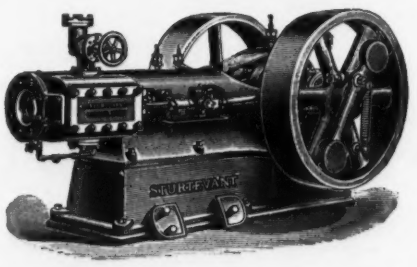

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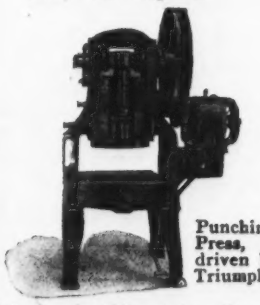

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